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DPR/PMA Final Report
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# Pesticide Risk Reduction in California Prunes
# Final Report 2001-2002

**Gary L. Obenauf**
California Dried plum Board
PMB# 345
7084 Cedar Avenue
Fresno, CA 93720
Phone: 559 322 2181
FAX: 559 322 2186
E-mail: gobenauf@agresearch.nu

California Dried plum Board/
California Dried Plum Board
P.O. Box 348180
Sacramento, CA 95834-8180

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**Management Team:**

Gary Obenauf, Project Manager for California Dried plum Board (CPB).
Bill Olson, Dried plum Farm Advisor-Butte, Sutter and Yuba Counties, University of California (UC), Cooperative Extension (CE), 2279-B Del Oro Ave., Oroville, CA 95965, ph. 530 538-7201, Fax. 530 538-7140, wholson@ucdavis.edu.
Rich Peterson, Executive Director, CPB, P.O. Box 348180, Sacramento, CA 95834-8180, ph. 916 565-6232, Fax. 916 565-6237, rpeterson@cdpb.org.
Fred Thomas, BPS coordinator, CERUS Consulting, P.O. Box 479, Richvale, CA 95974, ph. 530 891-6958, Fax. 530 891-5248, ceruscon@aol.com.
John Heier, 4880 E. Butte Road, Live Oak, CA 95953, ph.530 837 9845, Fax. 530 991 1837, jlhfarm@jps.net.
Mark Kettmann, 9281 Hwy. 70, Marysville, CA. 95901, ph. 530-742-3231, Fax 530-743-4213, mkettmann@marianipacking.com.
Danny Aguair, 14229 Avenue 180, Tulare, CA 93274, ph. 559-737-3606, Fax: 559-686-0442, danicu2@aol.com.
Bob Kolberg, 7486 E. Mission, Le Grand, CA. 95333, ph. 209-383-4070, Fax 209-383-4217, kolberg@madnet.net.
Joe Turkovich, 27606 Walnut Bayou Lane, Winters, CA. 95694, ph. 530-795-2689, Fax 530-758-1310, joeturkovich@aol.com.
Carolyn Pickel, Area IPM Advisor, UC-CE, 142-A Garden Hwy, Yuba City, CA 95991-5593, ph. 530 882-7515, Fax. 530 673-5368, cxpickel@ucdavis.edu.
Beth Teviotdale, Extension Plant Pathologist, UC-CE, Kearney Ag Center, 9240 S. Riverbend Ave., Parlier, CA 93648, ph. 559 646-6538, Fax. 559 646-6593, betht@uckac.edu.
Ken Shackel, Pomologist, UC, 3039 Wickson, Davis, CA 95616, ph. 530 752-0928, Fax. 530 752-8502, kashackel@ucdavis.edu.
Nick Mills, Entomologist, UC, Insect Biology 310 A Wellman Hall, Berkeley, CA 94720-3112, ph. 510 642-1711, Fax. 510 642-7428, nmills@nature.berkeley.edu.
Becky Westerdahl, Extension Nematologist, UC, Nematology 474 Hutchison, Davis, CA 95616, ph. 530 752-1405, Fax. 530 752-5809, bbwesterdahl@ucdavis.edu.
Larry Whitted, Whitted & Assoc., Box 4885, Fresno, Ca. 93744, ph. 209 225-8499, lrwhitted@aol.com.
Mark Dalrymple, Sunsweet Growers, 425 Macedo Road, Gridley Ca. 95948, ph. 530 751-5271, mdalrymple@sunsweetgrowers.com.
Rick Buchner, Cooperative Extension Tehama County, 1754 Walnut Street, Red Bluff, CA. 96080, ph. 530-527-3101, Fax 530-527-0917, rpbuchner@ucdavis.edu.
Brent Holtz, Cooperative Extension Madera County, 328 Madera Ave., Madera, CA. 93637, ph. 559-675-7879 Ext. 209, Fax 559-675-0639, baholtz@ucdavis.edu.
Bill Krueger, Cooperative Extension Glenn County, PO Box 697, Orland, CA. 95963, ph. 530-865-1107, Fax 530-865-1109, whkrueger@ucdavis.edu.
Maxwell Norton, Cooperative Extension Merced County, 2145 West Wardrobe Avenue, Merced, CA. 95340-6496, ph. 209-385-7403, Fax 209-722-8856, mnorton@ucdavis.edu.
Wilbur Reil, Cooperative Extension Yolo County, 70 Cottonwood Street, Woodland, CA. 95695, ph. 530-666-8143, Fax 530-666-8736, woreil@ucdavis.edu.
Steve Sibbett, Consultant, 2909 Village Ct. Visalia, CA 93277, Visalia, CA. 93291-4584, ph 559 734-4607, Fax 559 734-2708, sibbett@lightspeed.net

**CPB Research Subcommittee** – Jim Edwards, Ron Giovannetti, Eric Heitman, Mike Hurley, Mark Kettmann, Stan Lester, Ken Lindauer, Neil Mitchell, Ken Overly, Ron Sandage, Dennis Serger, Hans Smith, Todd Southam, Walter Stile Jr., Joe Turkovich, Don Vossler, Jeff Chan, Jerry Sneed, Chris Steggall, Pat Fierreira, Miguel Guzman, Steve Danna, Vernon Vereschagin, John Taylor, Larry Pantane, Steve Kollars, Dick Onyett, Ken Kaplan, Michael Billiou, Peter Orlando, Robert Hatch and Gregory Correa.

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## III. Executive Summary

Due to the impending loss of many pesticides, stricter use regulations, and concerns over contaminating natural resources, this project was begun to develop, research, demonstrate, and implement alternative practices that reduce pesticide use and conserve natural resources.

The core Integrated Dried plum Farming Practices (IPFP) project revolves around monitoring and developing treatment thresholds for pests, plant nutrition, and irrigation needs. Pests being studied include: European red and web-spinning mites, san jose scale, european fruit lecanium, dried plum aphids, peach twig borer, leaf-rollers, dried plum rust, and fruit brown rot.

Results from the past four years' pest monitoring and applying pesticide treatments only when a pest reaches treatment threshold indicated that by using monitoring/treatment threshold data being developed in this project, approximately 1,828,588 pounds a.i. of pesticides and their application could have been saved in 2002, approximately 1,957,566 pounds a.i. of pesticides and their application could have been saved in 2001, approximately 869,840 pounds a.i. of pesticides and their application could have been saved in 2000 and approximately 1,723,910 pounds a.i. of pesticides and their application could have been saved in 1999. The savings would have been mostly from unneeded dried plum rust treatments with a minor amount from unneeded dormant insecticide and oil treatments. The growers in this project saved approximately 13,580 pounds a.i. of pesticides in 2001, 6034 pounds a.i. in 2000 and 11,959 lbs a.i. in 1999.

Tree water status monitoring indicated that many growers in the program are applying more water than needed for best production; savings could occur when tree water needs are monitored and irrigation is applied only as needed. Estimates of savings appear to be around 40 percent when compared to current conventional irrigation scheduling practices.

Some grower/cooperators had well water with high levels of nitrate nitrogen, which would be utilized by the tree. This available nitrogen source was taken into account when fertilizer recommendations were made. This saved growers an average over 40 lbs of Nitrogen per acre in 2001.

Over 93 educational meetings, which discussed progress and implementation of the data being developed, were held in from 1999 to 2002, for an audience of over 3006 individuals interested in dried plum production. Sixteen newsletters were published and distributed to all 1,400 dried plum growers in California plus about 500 related industry members about the progress of the project. Electronic media was used in at least two counties to advise dried plum growers of pest status and "reduced risk" treatment options.

In 1999 Pest Control Advisors (PCA) began evaluating the monitoring techniques used in this project. The PCAs generally agreed with the treatment thresholds but felt that many of the monitoring techniques took too long. Efforts were made to streamline the monitoring techniques for wider acceptance.

## IV. Accomplishments

### PROBLEM AND ITS SIGNIFICANCE:

Economics and regulations are creating change in the way dried plums are farmed. Cost of farming is going up, the industry is experiencing problems with over production and the industry will no longer pay for small, poor quality fruit. Federal acts, such as the Federal Clean Air Act, Federal Food Quality Protection Act and California's Proposition 65 and 204 dealing with water quality, establish expiration dates and/or threaten continued use of many pesticides. Regulations established by California Department of Pesticide Regulation (DPR) have created new requirements and certification for application of pesticides. Misuse of natural resources is becoming a common environmental concern.

Alternative, low environmental risk practices, to the conventional way dried plums have been farmed, need to be researched and results demonstrated and implemented to adjust to current economics and approaching and/or existing regulations. Economic thresholds and monitoring techniques need to be discovered so that pesticide use can be safely reduced, or at least used in a timely fashion when needed. Water conservation that does not interfere with dried plum production needs to be researched and demonstrated.

Integrated Dried plum Farming Practices (IPFP) is a research/implementation project that includes 7 University of California (U.C.) dried plum farm advisors, 1 U.C. IPM advisor, 3 U.C. faculty members and one U.C. specialist to advance economically and environmentally sound approaches to dried plum production. The overall project was begun in 1998 with support from the California Dried plum Board.

Project objectives include:
I. Develop economic thresholds, monitoring techniques, and implement alternative pest control strategies that reduce use of conventional biocides
II. Demonstrate more effective use of fertilizers and natural resources.
III. Encourage adoption of reduced risk practices through outreach and extension efforts.

The objective is to compare and encourage adoption of cultural practices dealing with pest management, fertilization and irrigation between the conventional and more sustainable or "reduced-risk" approach to growing dried plums. Reduced-risk means a reduced risk to the environment without additional risk to the grower. After a few years of establishing these comparisons, an economic comparison will also take place.

### PROJECT INFRASTRUCURE:

The project was conducted in Tulare, Madera, Fresno, Yolo, Sutter, Yuba, Butte, Glenn and Tehama counties. Research and Implementation Orchards compared two dried plum-farming systems to an untreated check: 1) conventional system and 2) a "reduced-risk" system. Each system consists of at least 5 acres. The conventional system consisted of the grower's normal practices, but included an Asana and oil dormant spray. Pest control for the reduced-risk system was based on monitoring protocols developed for this project. A small untreated "check" area was also present at each site to help validate the two dried plum farming systems. Currently the project is being conducted on

individual dried plum farms ranging from Tulare to Tehama County, twenty-three sites total. There were 12 Research and Implementation orchards, 14 Implementation orchards and 11 319-grant orchards. Implementation orchards were orchards in this project that had converted totally to a "reduced risk" status. Pest control, fertilizer, and irrigation scheduling recommendations were based on field monitoring at each of the implementation sites. 319 grant orchards are just similar to implementation orchards except a dormant spray was applied. Those 37 sites were chosen, based on their location, to best represent the dried plum industry in California. Of the 14 Implementation orchards pest control advisors monitored 8 sites. The sites monitored by pest control advisors are sites that are "Reduced Risk" only. The PCA's monitor the orchard using pest protocols that were developed specifically for PCA's. See attached tables IPFP Research/Implementation Plots for County, Person Responsible, Grant Support, Grower, Plot Size, Acres Dried plums, Year Started and Total Acres Farmed. Also see IPFP Research/Implementation Plots/Practices for Pest Monitoring, Irrigation Scheduling, Cover Crops, Hedgerow Insectary and Fertilization at each plot.

Growers provide feedback and make suggestions on how to improve the program. PCA's and U.C. researchers provide guidance and input, as well as, help validated protocols.

*Monitoring:* The pests monitored included: san jose scale, european fruit lecanium, european red mite eggs, dried plum aphids, peach twig borer, the leaf roller complex, beneficial insects, dried plum rust, fruit brown rot, and spider mites. In addition, tree nutrient status and water status were monitored. Tree water status was used for irrigation scheduling purposes.

Field assistants (scouts) monitored each site. There were nine scouts assigned to the project. Monitoring data results in recommendations for the grower-cooperators about pest control, fertilization and irrigation scheduling. The cooperator agrees to apply these recommendations to the reduced-risk segment of the orchard. In many cases irrigation schedules could not be applied separately to the conventional and reduced-risk plots. In these cases our irrigation recommendations were applied in the entire plot. As new monitoring techniques and recommendations become available they will be incorporated into the project. These techniques and recommendations will, most likely, come from the satellite projects listed later and reported on separately.

*Evaluation:* Evaluation of these two farming systems was carried out using data collected throughout each season and final plot evaluations just prior to harvest. Additionally, these systems were evaluated based on California Dried Fruit Association (DFA) grade sheets and dry-away information provided by the participating farm advisors in 2002 and 2001, and P-1 grade sheets from growers in 1999 and 2000.

*Education/outreach:* The project required each of the 7 farm advisors to conduct at least one educational meeting each year focusing on reduced risk practices emanating from the IPFP project. Farm advisors were also encouraged to write newsletters and other popular articles about the IPFP project. Insect day-degree accumulation equipment was used to calculate day-degrees from the biofix for various pests. E-mail and web site communication between advisors and clientele, regarding pest monitoring, day-degree accumulation and field observations were encouraged.

*Funding:* It is recognized that the California Dried plum Board cannot support this project to the extent needed to attract rapid, wide adoption of reduced risk practices by clientele. To this end, additional grant support from other agencies is being sought to expand the project beyond the

capabilities of the California Dried plum Board. However, securing other grant funding is contingent upon dried plum industry support provided by the California Dried plum Board.

*Satellite projects:* Projects need to be researched before being demonstrated or adopted on a wide scale. "Satellite projects" to evaluate single aspects of reduced risk have been established in one or more areas. These satellite projects are "stand alone" projects. Their objectives are designed to address single researchable questions within IPFP. For example, evaluating aphid control with soft chemicals. Reduced risk satellite projects will be reported separately by those involved.

In 2002, the project supported research on:

1) Controlling mealy plum and leaf curl plum aphids using reduced rates of Diazinon and Asana with oil, in a dormant spray.
2) Controlling mealy plum and leaf curl plum aphids by using zinc to induce early fall defoliation.
3) Using pheromone traps to predict OBLR (Oblique-Banded Leaf Roller) populations and fruit damage.
4) A project using water traps to catch fall returning aphids to determine exactly when they return to lay their over-wintering eggs has begun.

In 2001, the project supported research on:

5) Controlling mealy plum and leaf curl plum aphids using reduced rates of Diazinon and Asana with oil, in a dormant spray.
6) Controlling mealy plum and leaf curl plum aphids by using zinc to induce early fall defoliation.
7) Using pheromone traps to predict OBLR (Oblique-Banded Leaf Roller) populations and fruit damage.
8) Literature and research review of dried plum aphid control using oils over the past ten years.
9) A project using water traps to catch fall returning aphids to determine exactly when they return to lay their over-wintering eggs has begun.

In 2000, the project supported research on:

1) Biological control of Mealy Plum Aphids using *Harmonia axyridis* lady beetles.
2) Pesticide efficacy trial using 2 types of oil and 1 type of pesticide for aphid control.
3) Alternate year dormant insecticide program evaluation.
4) A new aphid infestation-predicting model.

In 1999, material efficacy trials were conducted for control of dried plum aphids using soft materials including a number of novel products not yet registered.

Prior to 1999, this project supported research on:

1) An alternate year dormant spray program to cut pesticide use in half
2) A predictive model for forecasting scab off-grade at harvest,
3) Aphid control using soft chemicals
4) A "mow and throw" technique for weed control by either using cover crop residue following mowing or rice straw (ag-waste) as mulch for weed control down the tree row.

## PROJECT OBJECTIVES:

### I. Develop economic thresholds, monitoring techniques and implement alternative pest control strategies that reduce use of conventional biocides

Attached are the 15 protocols and data sheets we are currently using in the IPFP program.

### 1. Dormant Treatment Decision Guide

*Situation:* Dried plum growers have had no way of knowing if they need to apply a dormant insecticide and oil spray. The dormant spray has been in wide use because growers have been taught for many years that this is the most efficacious spray they can apply. It: 1) kills a number of pest including San Jose Scale (SJS), peach twig borer (PTB), European Red Mite (ERM), mealy plum aphid and leaf curl plum aphid, and 2) is least harmful to beneficials. Also many dried plum growers apply a dormant spray because there is no good reduced risk alternative to high populations of dried plum aphids. Recently the dormant spray has been implicated in polluting natural resources. These findings suggested that the dormant insecticide spray is being over used. A monitoring technique was needed to help growers decide if they required a dormant insecticide treatment.

*Evaluation:*
A fall aphid monitoring technique, orchard history evaluation of aphids and a dormant fruit spur monitoring technique were developed to see if these techniques would be useful in making dormant treatment decisions for dried plum aphids, SJS and European Fruit Lecanium (EFL). Since the project began, fall aphid monitoring data was correlated to spring aphid monitoring data to try and develop a model that could be used to predict the level of aphid infestation that would occur in spring, based on fall aphid counts. After 3 years of monitoring and comparing data, a correlation of only 46% (Significant at the 99% Level) was the best that could be achieved (Fig. 1A). However, the fall aphid monitoring technique proved to be 80% accurate (Significant at the 99% level) in predicting whether or not orchards will have aphids in the spring. In order to try and make the model more accurate, Tim Prather, an IPM Advisor, to see if he could think of ways to improve upon it, reviewed data. Tim came up with a model that is referred to as the Prather Aphid Predicting Model or "Prather Model" for short. This new model tried to account for the aphids flying to and from their alternate hosts in the late summer/early fall and considered geographic regions. It also assumed that if an orchard had a high population of aphids in the spring, the grower would spray for them and there would be less of a population that could return in the fall resulting in fewer aphids the following spring. The Prather Model did not have a significant correlation between predicted percent of trees to have aphids in the spring and the actual percent of trees to have aphids, with only 7 percent (Fig. 1B). In 2000, spring aphid counts in 1999 were compared to spring aphid counts in 2000 and found that there was 76% accuracy (Significant at the 99% level) in predicting level of aphid infestation. Based on the finding of previous years two treatment guides were developed in 2001. For orchards that had been receiving annual dormant insecticide sprays, treatment threshold is reached if: 1) one tree out of 40 trees monitored in fall has dried plum aphids; or 2) orchard history indicates at least one tree had aphids last season despite application of a dormant insecticide and oil; or 3) at least one aphid egg is found in the dormant spur sample. For orchards that have not been receiving dormant insecticide sprays, treatment threshold is based on orchard history. If 10% or more of the trees had aphids during the last growing season, then treatment threshold has been reached.

The sequential sampling dormant spur monitoring technique involved sampling spurs in winter for the presence of SJS or EFL crawlers and is the other part of the "Dormant Treatment Decision Guide". One hundred spurs are collected and 20 of them at a time are evaluated for presence of SJS and EFL. If, after evaluating the 20 spurs, a decision cannot be made, another 20 were evaluated and so on until all one hundred have been evaluated. In most cases the decision could be made after only looking at the first 20 spurs. The sequential sampling treatment threshold was based on 10 % of the spurs out of 100 having live scale (see Tables 1 & 2.).

**Figure 1A.**

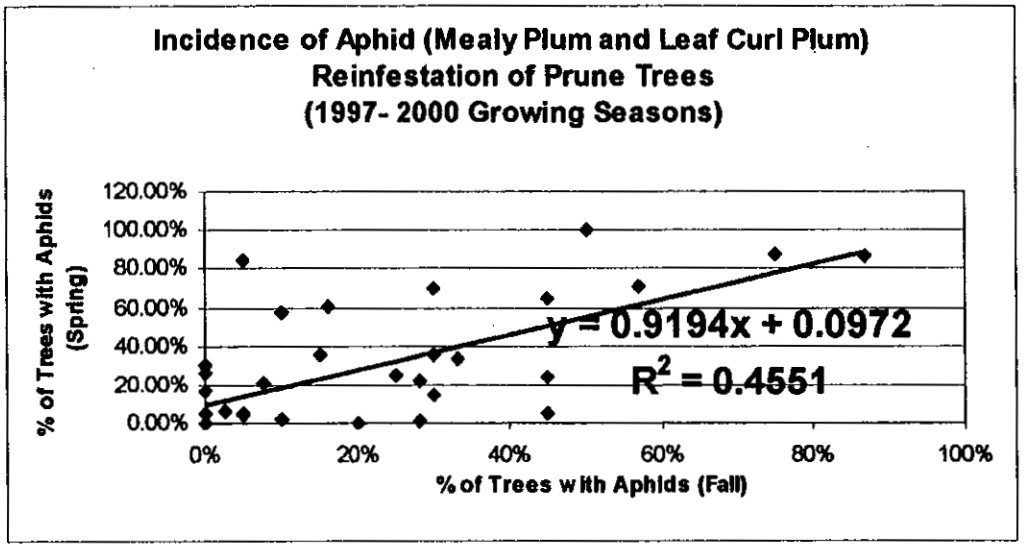



**Fig 1B**. Prather Model

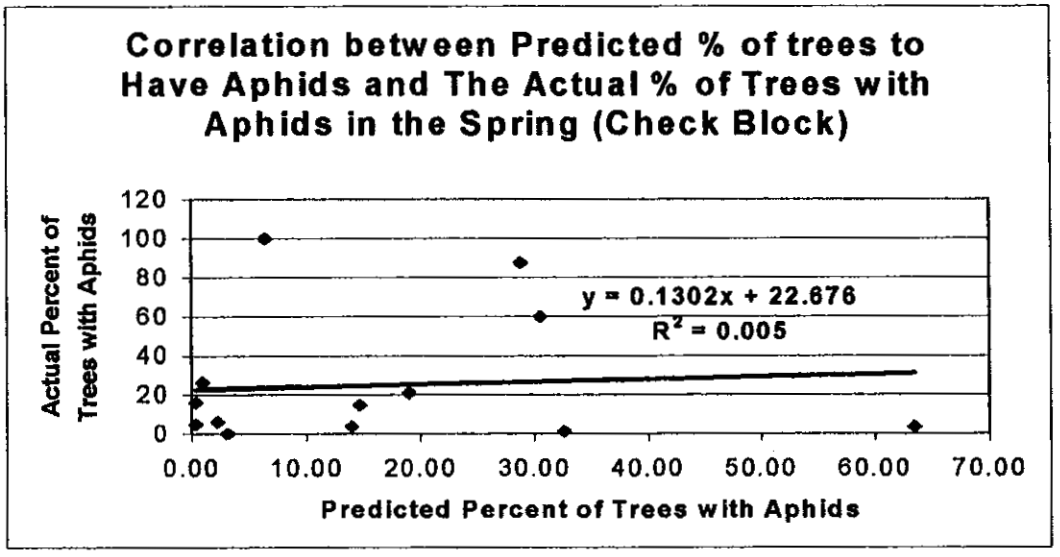


Table 1.

| Dormant Treatment Guide For Orchards That Have been Receiving Dormant Insecticide Sprays in The Past | | | |
|---|---|---|---|
| **Aphids present using methods 1, 2 or 3 (Y,N)** | **Scale above Threshold** | **Reduced Risk Treatment Reccomendation** | **Conventional Treatment Recommendation** |
| N | N | Nothing | Nothing |
| N | Y | Dormant Oil | Dormant Insecticide + Oil |
| Y | N | Oil at Green Tip or Growing season Insecticide or Growing season Oil* | Dormant Insecticide + Oil |
| Y | Y | | Dormant Insecticide + Oil |
| * Oil alone is not effective for Leaf Curl Plum Aphid once the leaves are | | | |
| 1) One tree out of the 40 trees monitored in the fall has prune aphids. | | | |
| 2) Orchard history indicates at least one tree had aphids last season | | | |
| 3) One or more aphid eggs are found in the dormant spur samples. | | | |

Table 2.

| Dormant Treatment Guide for Orchards That Have Not been Receiving Dormant Insecticide Sprays in The Past | | | | |
|---|---|---|---|---|
| **Orchard History Indicates:** | | **Scale above Threshold** | **Reduced Risk Treatment Recomendation** | **Conventional Treatment Recommendation** |
| **Below 10% of Trees Infested w/aphids** | **Above 10% of Trees Infested w/aphids** | | | |
| x | | N | Nothing | Nothing |
| x | | Y | Dormant Oil | Dormant Insecticide + Oil |
| | x | N | Oil at Green Tip or Growing season Insecticide or Growing season Oil* | Dormant Insecticide + Oil |
| | x | Y | | Dormant Insecticide + Oil |
| *Oil alone is not effective for Leaf Curl Plum Aphid once the leaves are curled. | | | | |

*Results:* The "Dormant Treatment Decision Guide" developed in 2001 accurately predicted, in every case, whether or not an orchard needed to be treated for Mealy Plum Aphid (MPA), Leaf Curl Plum Aphid (LCPA), SJS and/or EFL. One site that was predicted to have a LCPA problem was treated with a reduced risk treatment of oil 4 weeks after green tip with no success.

By using these guides in 2002 we found that only 2 of the orchards needed to treat for aphids and or scale in the spring that were not recommended to do so in the dormant season. However, both orchards had no aphid problems over the past three years and for some unknown reason, growers that hadn't ever had aphid problems were reporting aphids in their orchard this year.
In 2001 we found that 78.26% of the project orchards did not have an aphid problem and did not need a dormant insecticide and/or oil treatment for aphids while 21.74 % were predicted to have aphids and required a treatment of some kind (Fig 1C).

SJS populations in project orchards were found to be at treatable levels in 17.4 % of the project orchards in 2001 and 8.3 % in 2002 (Fig. 2). Overall 60.87 % of the orchards did not need to apply a dormant insecticide for either scale or aphids in 2001 and 57.14% in 2002 (Fig. 3).

As the distribution of project orchards was intended to represent the California dried plum industry, not treating 60.78 percent of the bearing dried plum orchards with a dormant insecticide and oil spray would result in a reduction of 156,812 lbs a.i. of pesticide in 2001 and 147,202 lbs a.i. in 2002 (based on all bearing acreage receiving a dormant spray of Diazinon at the recommended label rate).

*Conclusions*: Clearly a "Dormant Treatment Decision Guide" such as the one evaluated was very useful in making dormant treatment decisions in 2001 and 2002. Further evaluations of this guide will be conducted next year.

Over the next few years, surveys of growers will be conducted to determine the extent of implementation of the "Dormant Treatment Decision Guide."

**Fig. 1C**

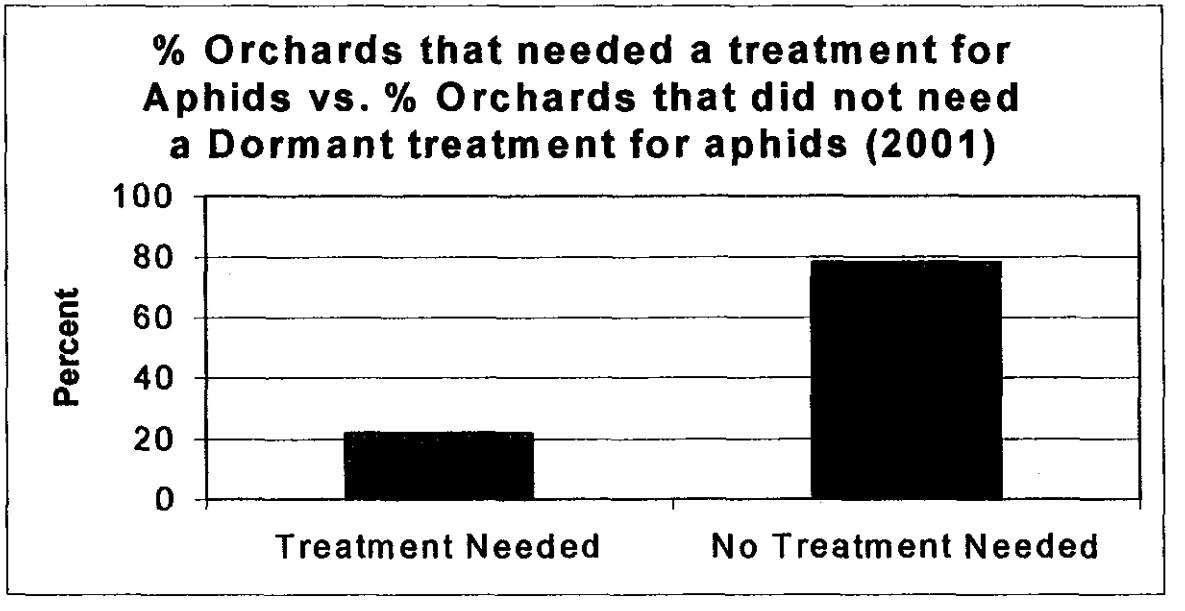


Fig 2.

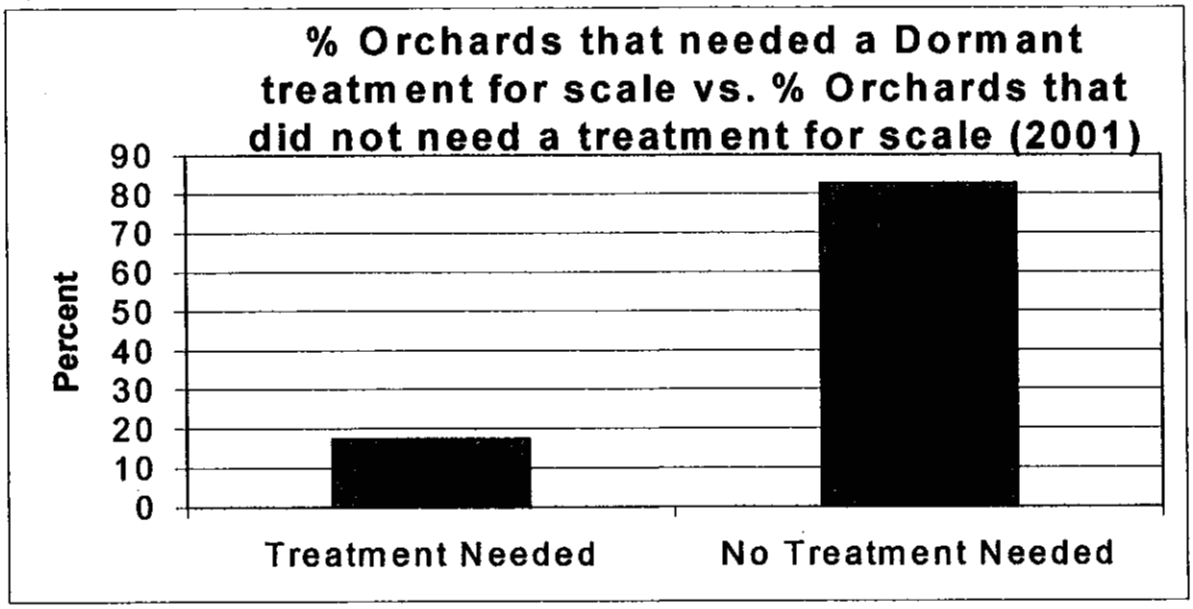
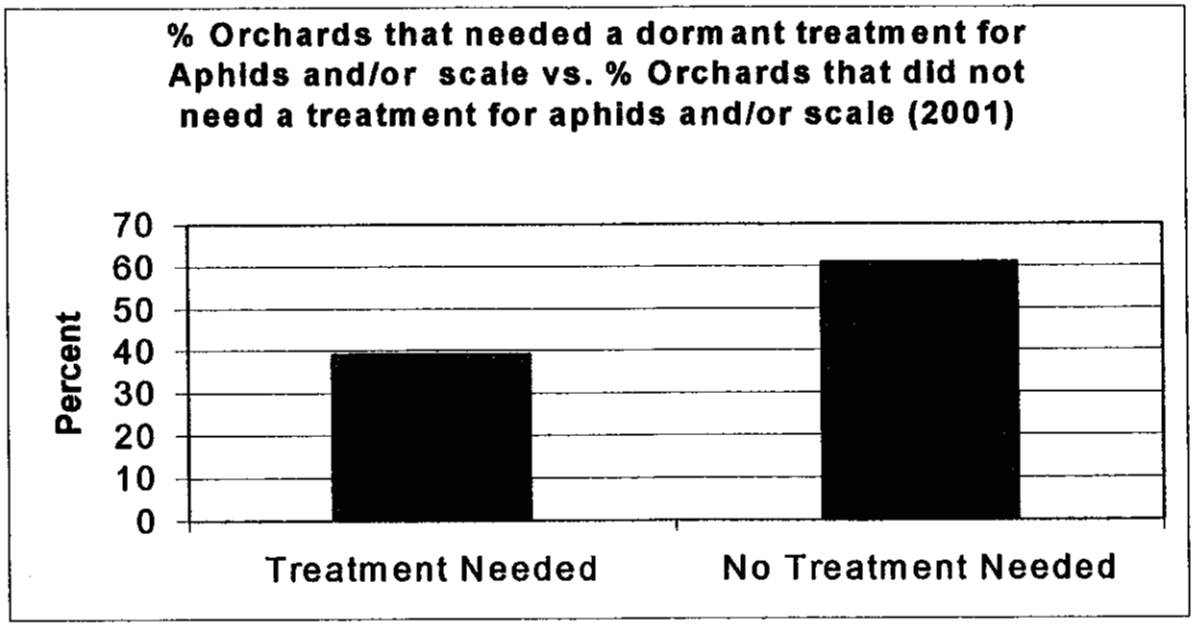



Fig 3.




**2. Pheromone Traps to Aid with Treatment Decisions**

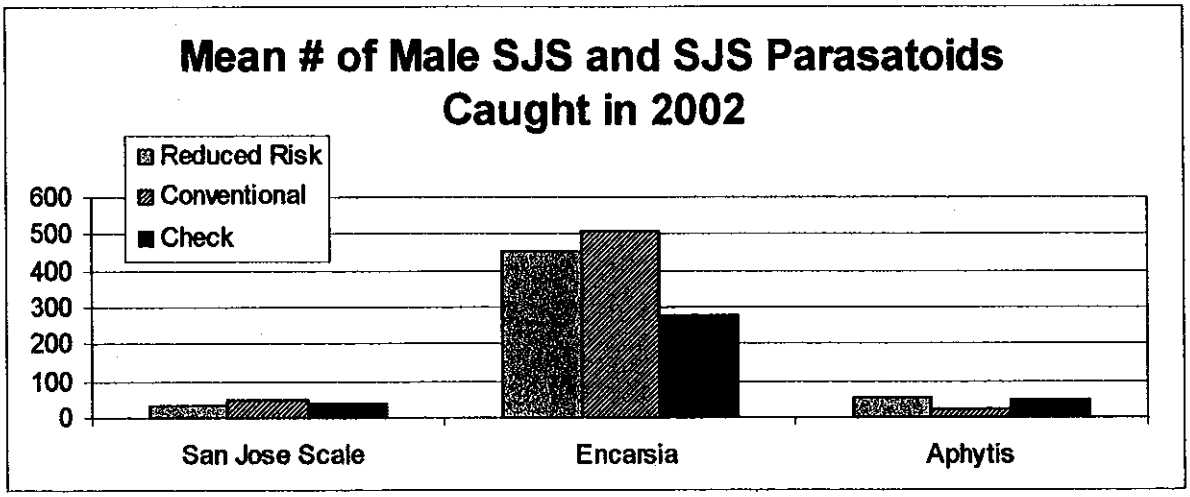
*Situation:* Pheromone traps have long been available but are generally underutilized by dried plum growers making treatment decisions. They, most commonly, are used to help determine treatment timing by calculating degree-days from when a biofix was obtained and, in the case of SJS traps, are also used to assess the presence of beneficial insects. Rarely have they been shown to be useful or have they been used to help determine if a treatment is needed. Information of this type could be useful to dried plum growers who may need to treat for PTB, OBLR or SJS.

**A. San Jose Scale**

*Evaluation:* By monitoring SJS pheromone traps in spring, the quantity of beneficial insects (*Encarsia (Prospatella)* and *Aphytis melimus)*, as well as, SJS males was documented in each orchard each year since 1999. For each site, 1000 fruit were examined per plot in July and near harvest for evidence of SJS crawlers.

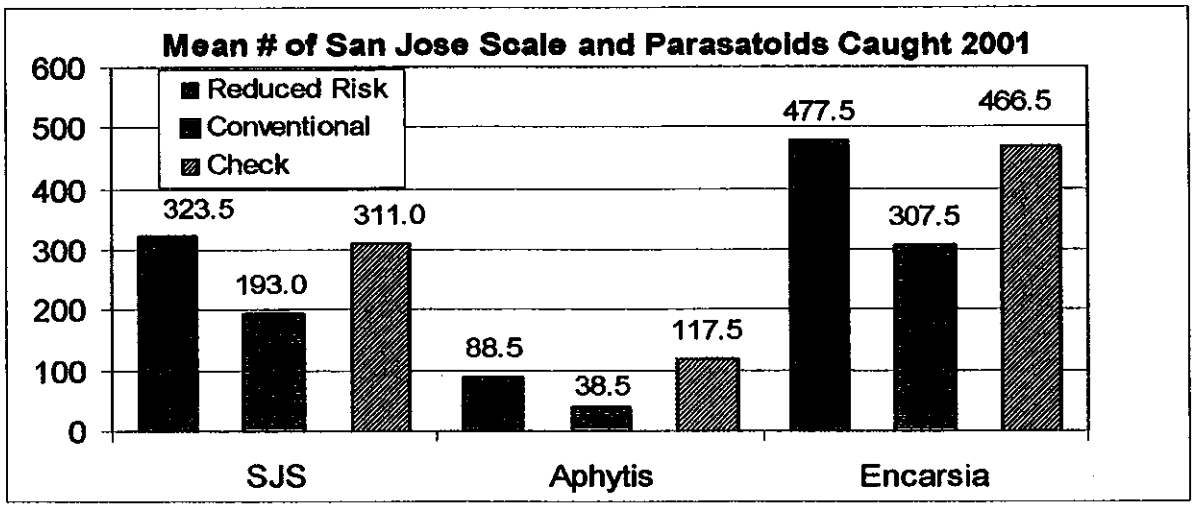
*Results:* No significant differences in pheromone trap catches were found for male SJS between the conventional, reduced-risk, and check plots in all four years (Figs 4 - 6). Significant differences in beneficial insects did occur. *Encarsia (Prospatella)* was caught in significantly larger numbers in reduced risk and check plots than in conventional plots in 2001 (Fig 4). No live or parasitized San Jose Scale was found on fruit during pre-harvest fruit evaluation in 2001(Table 4). However, some live SJS was found on fruit in the 2000 and 1999 crops (Tables 5 and 6).

**Fig 4a.**




No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

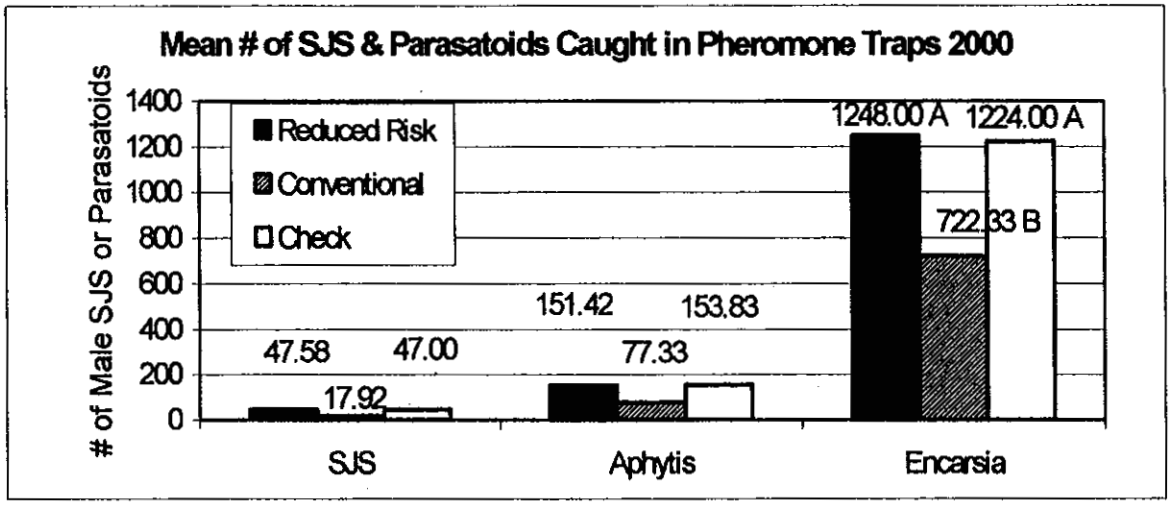
**Fig 4b.**




No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for

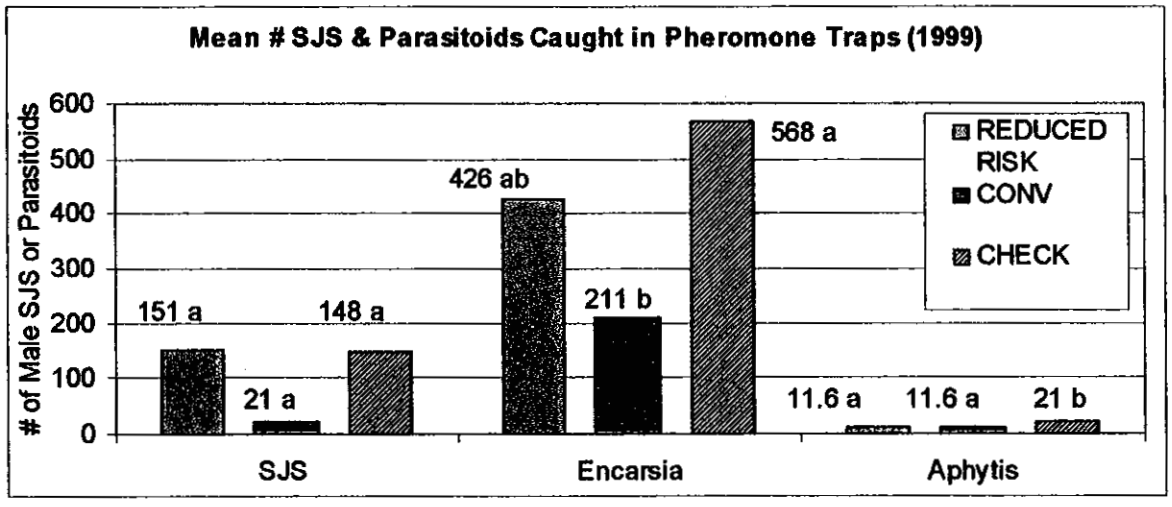
Mean Separation.

**Fig 5.**




Treatment means not followed by a common letter are significantly different from each other at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation.

**Fig 6.**




Treatment means not followed by a common letter are significantly different from each other at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation.

**Mean % Fruit w/ SJS or Parasitized SJS Present at Harvest (2002)**

| TREATMENT | % Fruit w/ SJS* | % Fruit w/ Parasitized Scale* |
|---|---|---|
| REDUCED RISK | 0 | 0 |
| CONVENTIONAL | 0 | 0 |
| CHECK | 0 | 0 |

No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

**Table 4. Mean % Fruit w/ SJS or Parasitized SJS Present at Harvest (2001)**

| TREATMENT | % Fruit w/ SJS* | % Fruit w/ Parasitized Scale* |
|---|---|---|
| REDUCED RISK | 0 | 0 |
| CONVENTIONAL | 0 | 0 |
| CHECK | 0 | 0 |

No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

**Table 5. Mean % Fruit w/ SJS or Parasitized SJS Present at Harvest (2000)**

| TREATMENT | % Fruit w/ SJS | % Fruit w/ Parasitized Scale |
|---|---|---|
| REDUCED RISK | .01 ab | 0.03 |
| CONVENTIONAL | .03 a | 0 |
| CHECK | 0 b | 0.02 |

Treatment means not followed by a common letter are significantly different from each other at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation.

**Table 6. Mean % Fruit w/ SJS or Parasitized SJS Present at Harvest (1999)**

| TREATMENT | % Fruit w/ SJS | % Fruit w/ Parasitized Scale |
|---|---|---|
| REDUCED RISK | 1.1 ab | .01 |
| CONVENTIONAL | .25 b | 0 |
| CHECK | 2.01 a | 0 |

Treatment means not followed by a common letter are significantly different from each other at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation.

*Conclusion:* Presence of more parasitoids in reduced risk and check plots, where dormant insecticides had not been applied for 3 or more years, indicates the dormant insecticide with oil treatment reduced populations of these beneficial insects. SJS traps gave a good indication of scale and scale parasites in the orchard. 1999 was the worst of the three years for SJS damage. However, there was no significant difference between the reduced risk plots and conventional plots. One of the main reasons no significant difference occurred was an oil application alone can be used to control SJS the dormant and delayed-dormant periods.

**B. Peach twig borer (PTB)**

*Situation:* In previous years, research correlating PTB pheromone trap catches with damaged fruit at harvest was conducted. Results found a correlation ranging from 60 to 80 percent. However, even though this technique looked promising, PCAs and growers said that they would not use it. Besides comparing trap catches to damage at harvest, live PTB larva and PTB damage during the season were also evaluated. A very high correlation was the result of the comparison. However, no PCA or grower would monitor 80 trees per orchard every week; it would be too costly and time consuming.

*Evaluation:* Currently PCAs and growers use PTB pheromone traps to obtain a biofix and then base their sprays on degree-day accumulation. So this year (2002) and last year, using previous research data, we evaluated a one-time fruit monitoring technique that a PCA or grower would be more inclined to use. PTB pheromone traps were used to obtain a biofix. 400 day-degrees after biofix, 1200 fruit were evaluated in each plot for presence of PTB larva or damage. Based on this fruit

evaluation, a treatment decision could be made based on a threshold of 1% of fruit having larva and/or larva damage. The 1% threshold was chosen based on an average crop of 2.5 ton per acre and a price of $800/ton; this would equal the cost of an insecticide spray. By applying an insecticide spray for worms you would lessen chances of more worm damage and onset of brown rot. However, if the orchard history indicated that last year's crop had significant worm damage then, two-bloom time *B.t.* sprays (one at "popcorn" and again ten days later) were recommended. For each site, 1000 fruit were examined per plot in July and near harvest for evidence of PTB larvae or damage.

*Results:* In 2001, the fruit evaluation at 400 day-degrees after biofix found none of the project orchards needed a growing season PTB treatment based on the treatment threshold for dried plums, 1%. The July sample found only one orchard had PTB larva and/or damage over 1 % with 1.3 % damage. At harvest only one orchard, a different one had PTB larva and/or damage of over 1 % with 1.4 % damage. There was no significant difference in PTB damaged fruit between the conventional and reduced risk plots at harvest (Table 7.) Based on previous orchard history of having over 4 % of the fruit damaged due to PTB larvae, one orchard received two bloom-time B.t. sprays (one at popcorn and again ten days later). The same orchard also received a growing season insecticide even though the orchard did not exceed the treatment threshold for dried plums. The grower applied the treatment based on the assumption that he was going to sell some fruit to the fresh market and he wanted as little worm damage as possible. Based on the 400 degree-day fruit evaluation that revealed 2.29 % PTB damage in the untreated area, a spray was suggested. This strategy was successful compared to PTB damage found in the check (Table 8). In 2002 the fruit evaluation at 400 day-degrees after biofix found none of the project orchards needed a growing season PTB treatment based on the treatment threshold for dried plums, 1%. At harvest no orchards had PTB damage of 1% or more.

**Table 7. Mean % Fruit with PTB Damage Present 2001**

| Treatment | 400 Degree-Days | July PTB Damage | Harvest PTB Damage | DFA Disease/Insect Offgrade |
|---|---|---|---|---|
| Reduced Risk | 0.1 | 0.7 | 0.4 | 0.6 |
| Conventional | 0.0 | 0.6 | 0.3 | 0.5 |
| CHECK* | 0.1 | 0.7 | 0.4 | 0.5 |

No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

* Reduced Risk and the Check plots were both untreated; therefore reduced risk plot data was used The only reduced risk plot that received a treatment for PTB in 2001is shown separately in Table 8.

Table 8.

| % Fruit with PTB Damage (Butte County Orchard) 2001 | | | |
|---|---|---|---|
| | Bt + Inseason Insecticide + Monitoring | Dormant Insecticide + Inseason Insecticide + Monitoring | Untreated Check |
| 400 Degree-Days | 0.8 | 0.3 | 2.9 |
| July Evaluation | 0.2 | 0.0 | 1.8 |
| Harvest Evaluation | 0.7 | 1.4 | 2.3 |
| DFA Disease/Insect Offgrade | 0 | 0 | 1.3 |

No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

*Conclusion:* Fruit monitoring based on a PTB biofix using pheromone traps was a useful tool in determining treatment necessity and timing in 2001 and 2002. However, more research on this method will need to be conducted. A 1% treatment threshold may be correct based on the fact that at harvest, DFA found very low levels of worm damage in the fruit when the 400 degree-day evaluation was below 1% (Table 7), but found, when there was more than 1% worm damage in the dried fruit, levels were also above 1% at 400 degree-days (Table 8) in 2001. The block that had worm damage above 1% at 400 degree-days was an untreated check.

Over the next few years, surveys of growers will be conducted to determine the extent, if any, of implementation of the fruit sampling at 400-degree days technique.

**C. Oblique Banded Leaf Roller (OBLR):**

*Demonstration:* Research using OBLR trap catches and fruit monitoring was conducted and evaluated in previous years (1999-2000) just as the PTB research described above. However, this year (2002) and last year (2001) a one-time sample could not be tested because exact degree-days for OBLR in dried plums were not known. Starting at 690 degree-days (degree days recommended on other crops) weekly fruit monitoring was conducted for 3 weeks (to determine best evaluation timing) in each plot for the presence of OBLR larva or damage. Based on fruit evaluation a treatment decision could be made. However, if the orchard history indicated that last year's crop had significant worm damage then, two-bloom time *B.t.* sprays (one at popcorn and again ten days later) were recommended. For each site, 1000 fruit were examined per plot in July and near harvest for evidence of OBLR larvae or damage.

*Results:* Weekly fruit evaluation, beginning 690 day-degrees after biofix, found that none of the project orchards needed to apply a growing season OBLR treatment. The treatment threshold for dried plums is 1% of the 1200 fruit sampled for 3 weeks starting at 690 degree-days having OBLR larva and/or OBLR damage. The 1% threshold was chosen based on an average crop of 2.5 ton per acre and a price of $800/ton would equal the cost of an insecticide spray. By applying an insecticide spray for worms you would lessen the chances of more worm damage and the onset of brown rot. The July sample found six orchards had OBLR larva and/or damage over 1 % with 2.5 % being the

highest. At harvest five orchards had OBLR larva and/or damage of over 1 % with 2.5 % being the highest. There was no significant difference between the conventional and reduced risk plots in the amount of OBLR damaged fruit found at harvest (Table 9a and 9b.)

**Table 9a. Mean % Fruit with OBLR Damage Present (690 Degree-Days + 2 weeks, July and Harvest Final Evaluations) 2002**

| Treatment | 690 Degree-Days + 2 weeks | July OBLR Damage | Harvest OBLR Damage |
|---|---|---|---|
| Implementation | 0.37 | 0.17 | 0.41 |
| Reduced Risk | 0.35 | 0.24 | 0.24 |
| Conventional | 0.12 | 0.24 | 0.14 |
| CHECK | 0.35 | 0.24 | 0.24 |

No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

**Table 9b. Mean % Fruit with OBLR Damage Present (690 Degree-Days + 2 weeks, July and Harvest Final Evaluations) 2001**

| Treatment | 690 Degree-Days + 2 weeks | July OBLR Damage | Harvest OBLR Damage |
|---|---|---|---|
| Reduced Risk | 0.5 | 0.9 | 0.8 |
| Conventional | 0.5 | 0.4 | 0.7 |
| CHECK | 0.5 | 0.9 | 0.8 |

No significant difference at the 95% confidence level according to Duncan's Multiple Range Test for Mean Separation

*Conclusion:* Fruit monitoring based on an OBLR biofix, using pheromone traps can be a useful tool in determining treatment necessity and timing. However, more research on this method will need to be conducted.

**3. Spring Dried plum Aphid Monitoring**

*Situation:* Without a dormant insecticide and oil treatment it will be important to assess aphid populations in-season to determine if treatments are needed.

*Evaluation:* Beginning in April, a random sample of 80 trees per plot was observed weekly to determine presence of leaf curl plum aphids (LCPA) and mealy plum aphids (MPA) (1999-2000). The treatment threshold was 10 percent or more of the trees having aphids. In 2001, the treatment threshold was changed based on research done by Dr. Nick Mills, U.C. Berkeley. If more than 20 percent of the trees were significantly infested (aphids covering 10% of tree surface or more), then treatment was recommended. Recommendations ranged from an oil treatment to suppress MPA, to an insecticide treatment to eliminate MPA or LCPA.

In 2001, a statistician developed a sequential sampling technique for dried plum aphids from previous

year's data. Sequential sampling allows for a small number of trees (20) to be sampled. From this small sample if a decision to treat is predicted, then sampling can stop. If MPA and/or LCPA aphid levels are determined to be very low, sampling can also stop. If MPA and/or LCPA levels are moderate (more than very low, but not enough to call for a treatment) then additional trees (10) need to be sampled. Continued sampling an additional 10 trees is needed until a decision can be made or 80 trees have been sampled.

In 2002, we used the sequential sampling thresholds to adopt a timed search. The initial search would be for ten minutes (approximately 40 trees) and you would record the same info as before. If a decision couldn't be a made an additional 5 minutes would be spent looking at more trees. The total time allowed for monitoring is 20 minutes.

*Results:* After following the dormant treatment recommendation based on the "Reduced Risk Dormant Treatment Decision Guide" two orchards out of 24 exceeded the treatment threshold for aphids during the growing season in 2002. Neither orchard had an aphid problem or a dormant spray in the past 3 years. Once orchard is trying to be organic and their problem was LCPA. They tried a new organically approved insecticide but it did not work. The other orchard had an MPA problem and an oil treatment stopped that. Four other orchards also exceeded the treatment threshold for aphids, however those growers chose not to follow the recommendation. One of the four chose to not treat at all and had a high mealy plum aphid population all season.

After following the dormant treatment recommendation based on the "Reduced Risk Dormant Treatment Decision Guide" one orchard out of 23 exceeded the treatment threshold for leaf curl plum aphid during the growing season in 2001. This orchard was accurately predicted to have an aphid problem, but the reduced risk oil treatment was applied too late to be effective. None of the orchards that followed the treatment recommendation exceeded the threshold for MPA during the growing season. However, one orchard that did not follow the treatment recommendation did exceed the treatment threshold for MPA.

The sequential sampling technique was compared to the conventional sampling method of looking at all 80 trees and produced the same results as the conventional technique.

During the final evaluations, 40 fruit (from up to 25 trees) were examined from trees, which had been infested by MPA, and 40 fruit (from up to 25 trees) were examined from trees that had not been infested by MPA. Example: if only 10 trees in the orchard had aphids, then only 10 trees that did not have aphids would be evaluated. Trees with MPA present did not have significantly higher levels of side cracks, end cracks or total cracks present on fruit than trees without aphids in 2002 or 2001, but both years showed higher numerical levels of cracks on trees with aphids (Fig 7a and 7b). However, in 2000 trees with aphids did have significantly more end and side fruit cracking (Figs 8 and 9).

**Fig 7a. Mean % Fruit Cracking due to Mealy Plum Aphids 2002**

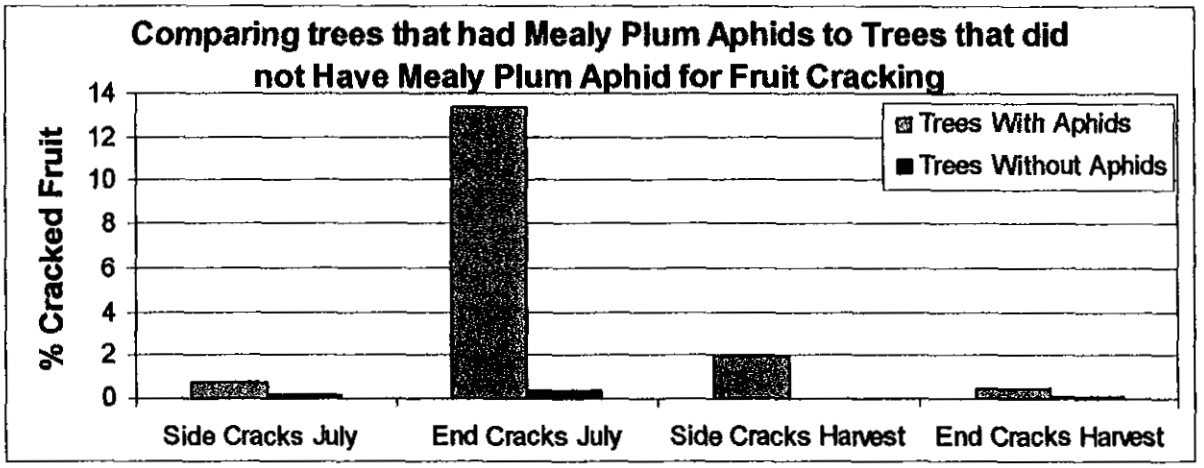



**Fig 7b. Mean % Fruit Cracking due to Mealy Plum Aphids 2001**

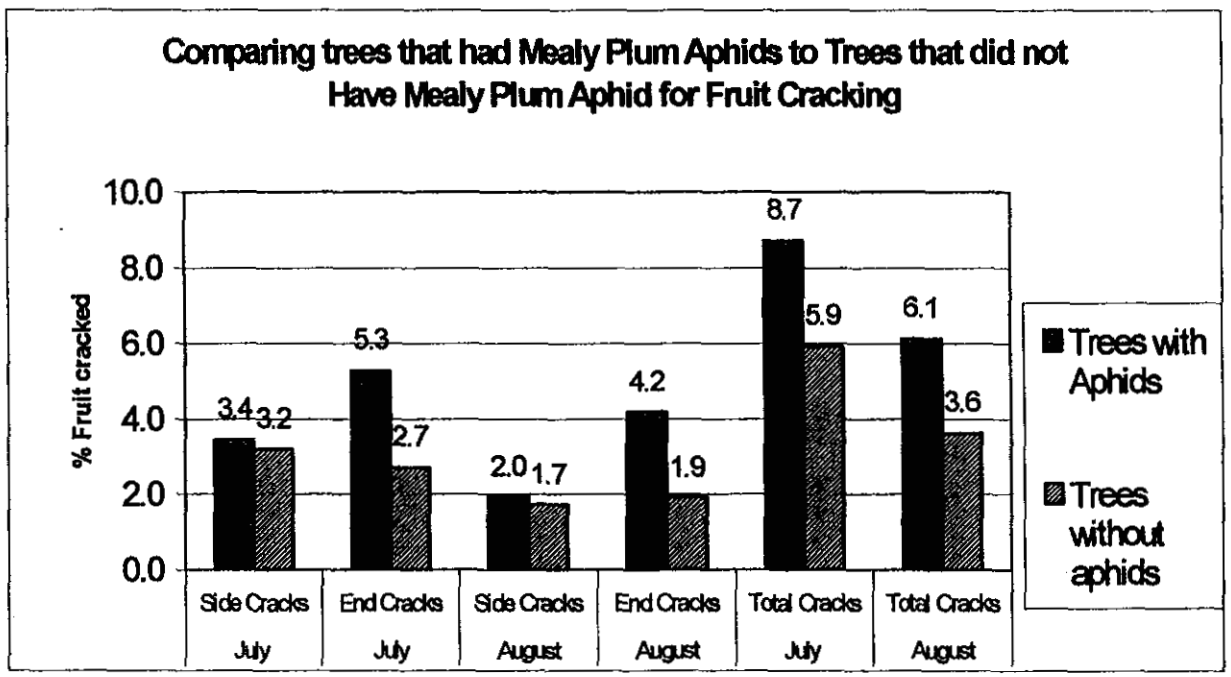


Fig8.

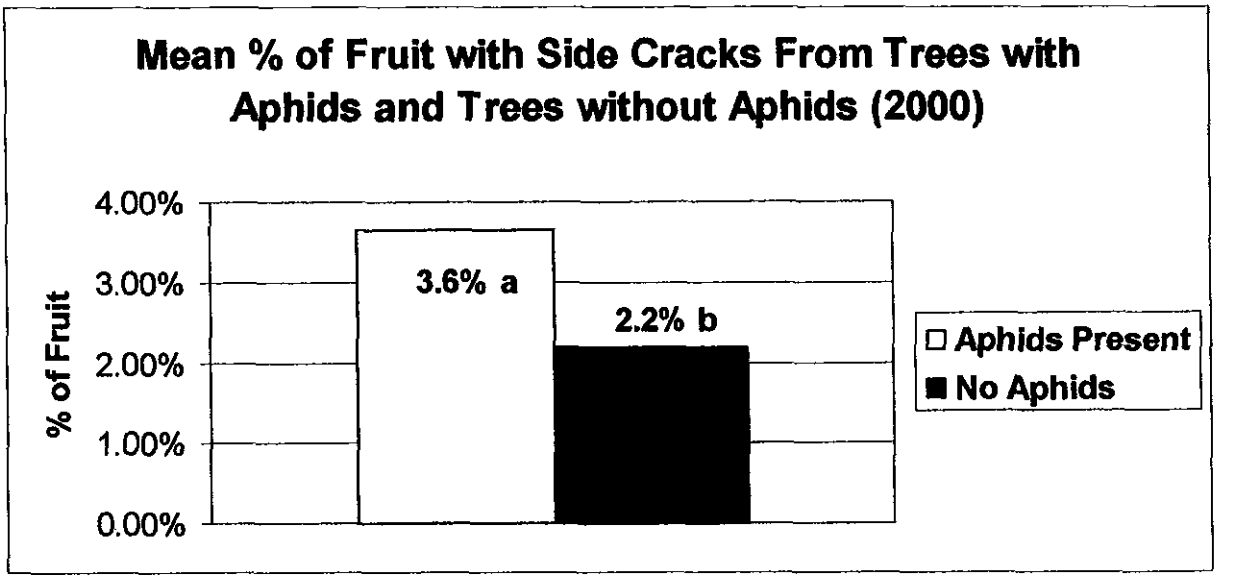
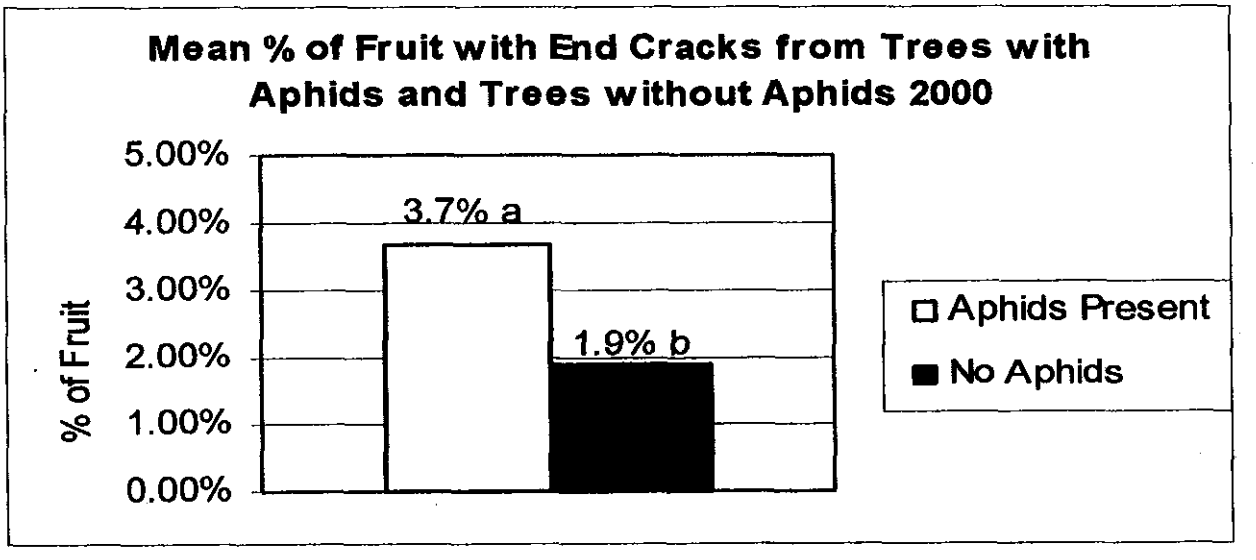



Fig 9.




Treatment means that are not followed by a common letter are significantly different from each other at the 95% level of confidence according to Duncan's Multiple Range Test for Mean Separation.

*Conclusion:* The timed search monitoring technique proved to be a slight improvement on the sequential sampling technique. The sequential sampling technique for aphids was just as accurate and much quicker than looking at all 80 trees. Using the new sequential sampling technique for presence of aphids gave us a good indication of when, and if, a treatment was needed. Only 8.3 percent of all orchards that did not receive a dormant spray needed a growing season insecticide treatment for aphids in 2002 and only 8.7% in 2001; compared to 42% of the orchards in 2000 and 45% in 1999. According to this information, a growing season aphid spray would have resulted in 235,554 lbs a.i. less pesticide being applied (based on applying Diazinon at the recommended label rate to all bearing dried plum acreage) in 2001 and 236,586 lbs of a.i. in 2002. None of the comparison orchard's conventional plots, which received a dormant spray, needed a growing season spray in all three years. The treatment threshold (20 percent of significantly infested trees) appears to be fairly accurate.

Harvest evaluations in 2001 did not statistically verify previous information that dried plum aphids cause fruit cracks. Many of the trees that had MPA did not have a significant aphid population (10% or more of the tree infested with aphids). This may be the reason that there was no significant difference in fruit cracking in 2001. However, previous data from this project does show that aphids do cause fruit cracking (Figs 8 and 9). End cracks appear associated with aphids more than side cracks.

Over the next few years, surveys of growers will be conducted to determine the extent, if any, of implementation of the sequential aphid monitoring technique

**4. Dried plum Rust Monitoring and Treatment Timing Recommendations:**

*Situation:* Rust control is the most common pest treated during the growing season. Growers currently have no way to monitor dried plum rust. Most growers simply apply one or more protective wettable sulfur treatments in May, June and/or July following rain.

Previous research has shown rust treatments applied close to onset of rust infection are most beneficial and provide protection for about two weeks. Teviotdale and Sibbett have shown that post harvest defoliation from rust has no influence on subsequent fruit quality or productivity. In 1997 Olson, Krueger, and Teviotdale reported the appearance of rust infection on leaves has no influence on fruit soluble solids, dry away, size, etc. Fruit soluble solids, dry away, size, etc. can be affected if rust causes defoliation prior to harvest.

*Evaluation:* Since the beginning of this project forty orchard trees in each plot of each site were selected for monitoring. Monitoring for rust was initiated May 1st and continued every week in the Sacramento Valley and every other week in the San Joaquin Valley until mid-July if no rust was found. If rust was found, monitoring continued until approximately 4 weeks prior to harvest. Once rust was detected, a treatment was recommended. After a rust treatment was applied, and continued monitoring indicated an increase in rust, additional treatments were recommended. This year (2002) the monitoring switched to a random 40-tree search. This led to a broader search area and a faster detection method.

*Results:* 16 percent (4 of 24) of all of the orchards had rust before the July 15 in 2002. Three of the orchards treated for it and one did not. None of the orchards had any defoliation due to rust at harvest time. Fifty percent of the comparison orchards had rust and thirty-three percent of the implementation orchards had rust in 2001. A determination of defoliation near harvest revealed none of those orchards had any defoliation due to rust in 2001 or 2000 (Figs 10 and 11). The orchard that had the longest interval between discovery of rust and harvest in 2001, 7 weeks prior to harvest, resulted in no defoliation by harvest time (Fig 10). In 2000, rust was discovered 6 weeks prior to harvest with no defoliation by harvest time (Fig 11). However, in 1999 there was some defoliation due to rust at harvest when rust was discovered 4 weeks prior to harvest (Fig 12).

Fig 10.

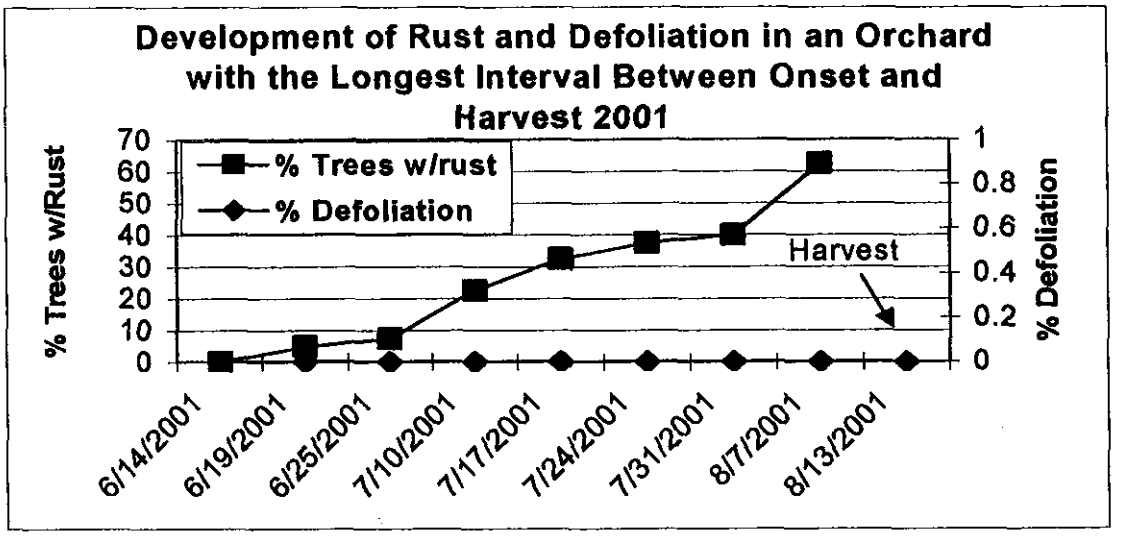



Fig 11.

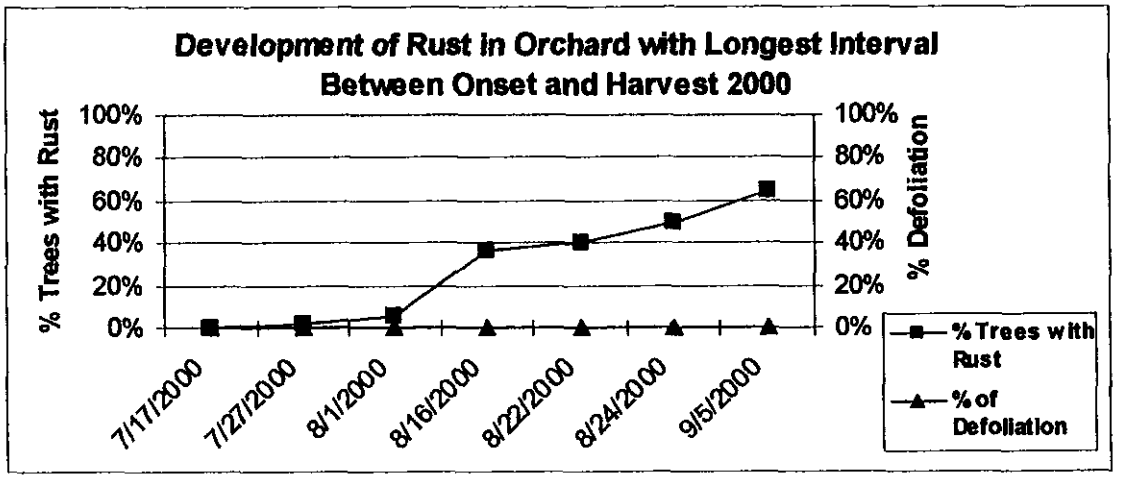
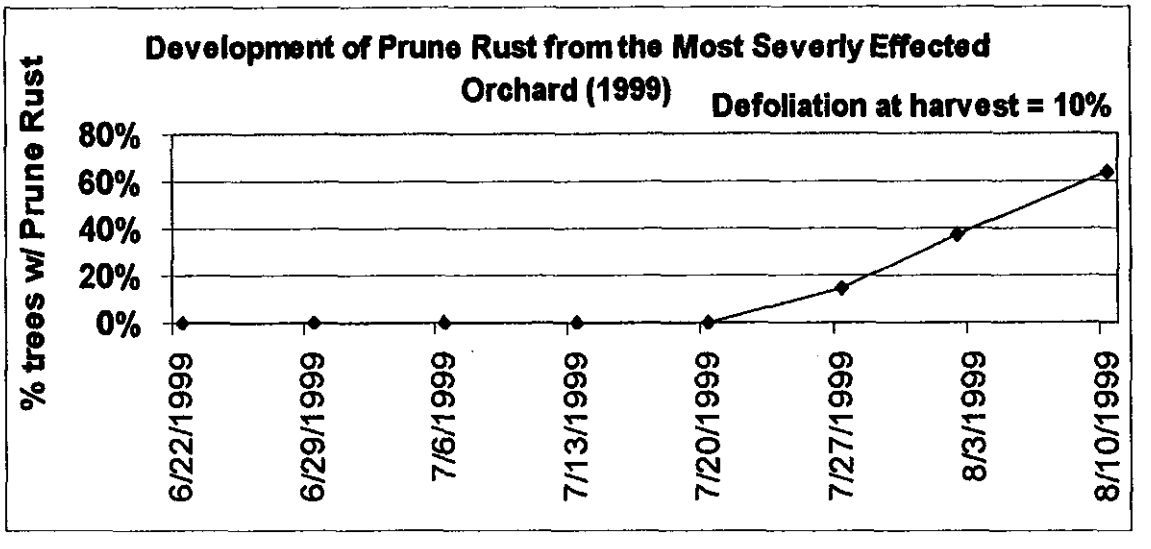



Fig 12.



*Conclusion:* Monitoring dried plum rust is a fairly simple technique. It takes one person less than 30 minutes to evaluate an orchard. In 1999 only one orchard had 10 percent defoliation from rust and that was when rust was detected five weeks before harvest. In 2000, no defoliation from rust occurred when rust was detected six weeks from harvest. In 2001 no defoliation from rust occurred even when rust was detected seven weeks from harvest. This suggests that rust monitoring and rust treatments can be eliminated 4-6 weeks before harvest. In coming years, eliminating rust treatments at 5 or more weeks prior to harvest will be evaluated.

This monitoring technique has the potential of greatly reducing rust treatments. Eighty-four percent of all orchards monitored this year (2002) and Ninety-One percent last year (2001) had either no rust or rust was found only after rust was no longer a potential problem (4 weeks prior to harvest). Nine percent of the orchards had rust before the harvest treatment deadline of 4 weeks prior to harvest, but chose not to apply a treatment due to projected poor crop revenues in 2001. Had all dried plum growers followed this rust monitoring program in 2001 it would have reduced 1,565,200 pounds of pesticide applied and in 2002 1,444,800 pounds (based on all bearing dried plum acreage receiving 1 sulfur application for rust at 20 lbs/acre).

Over the next few years, grower surveys will be conducted to determine implementation extent of the rust monitoring technique for treatment need and timing.

**5. Presence–Absence Sequential Sampling for Web spinning Mites:**

*Situation:* Dried plums are occasionally infested by web-spinning mites and require an in-season treatment. There are no established treatment thresholds for web-spinning mites in dried plums, so the treatment threshold for almonds was used. Pest control advisors use subjective judgment when determining need for mite treatment that is difficult to document and teach growers. When growers make their own treatment decisions it is generally based on visible damage or on calendar date. This is often too late, too early, or unneeded. A presence-absence web-spinning mite monitoring technique was developed for almonds and is being validated for dried plums.

*Evaluation:* In 1999, the presence-absence sequential sampling for web-spinning mites consisted of sampling 15 leaves from 10 trees per plot for presence of web-spinning and beneficial mites/predators. Sampling began around June 1 and continued for 10 weeks. Since 2000 the number of trees monitored dropped from 10 to 5 per plot due to the length of time it takes to complete monitoring. The treatment threshold was established when over 53 percent of the leaves had web-spinning mites or eggs with mite predators present, or 32 percent of the leaves have web-spinning mites/eggs with no predators present. Sampling took 30 – 45 minutes (5 trees per plot) and was done every other week until 20 percent of the leaves had mites. Once this level was reached sampling was done weekly.

*Results:* Monitoring showed a progressive buildup of mites and decline of predators in 2001 and 2000 (Figs 13 and 14). In 2002, the mite population only reached treatable levels in 3 of the orchards. Only one orchard had a treatment applied. The other two orchards chose to not treat and luckily the Mite population stalled in early august and the predator population caught up. In 2001 trees with no defoliation averaged slightly higher soluble solids than trees with defoliation; however there was no statistical difference between them (data not shown). In 2002 none of the orchards had any defoliation due to mites at harvest. There was no statistical difference between web-spinning mite populations or mite predator populations in the orchards with reduced risk, conventional, and check

plots (data not shown) from 1999 to 2002.

**Fig 13.**

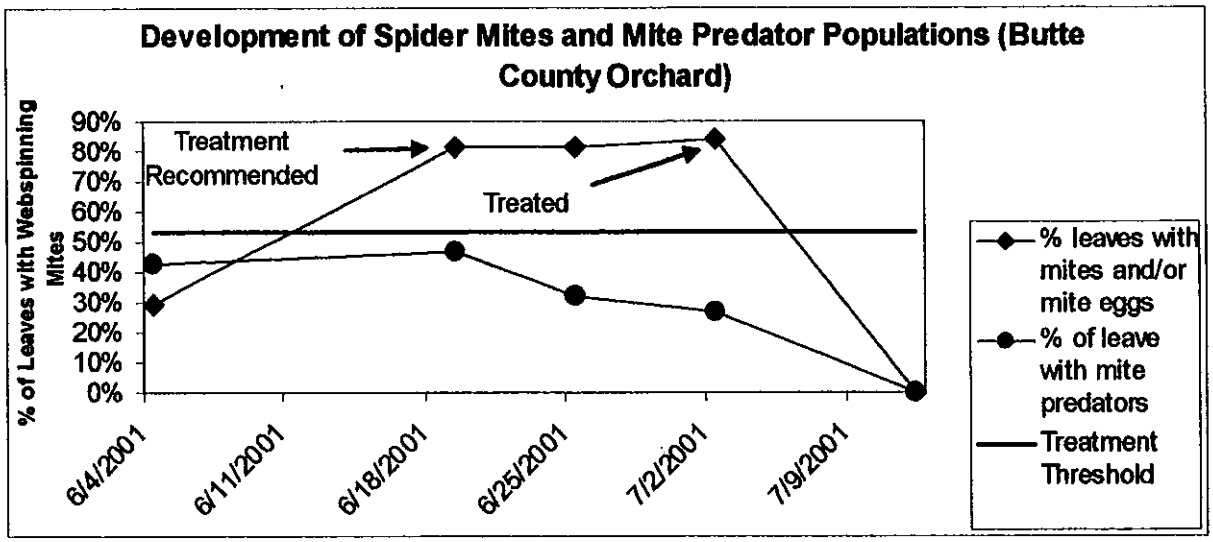
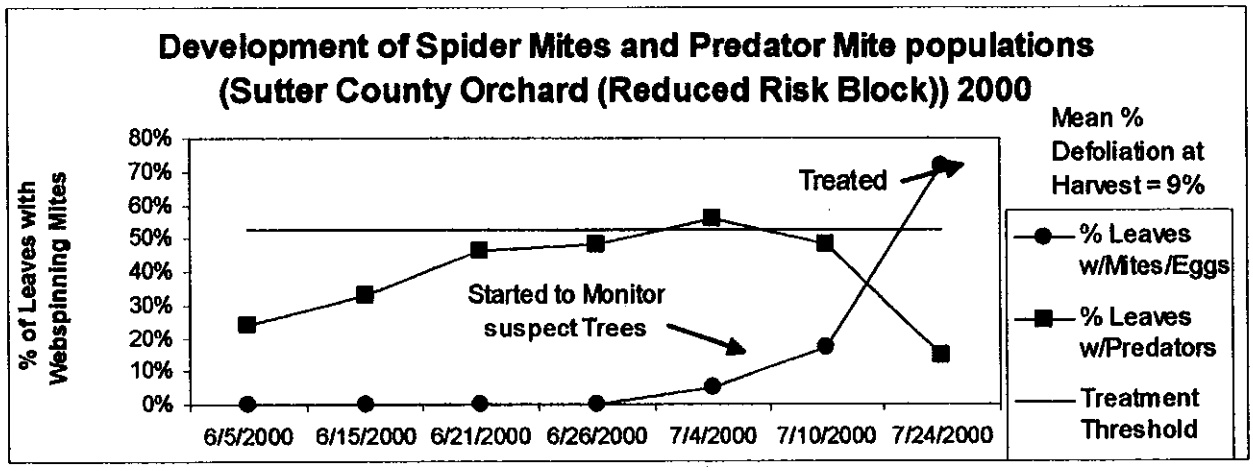



**Fig 14.**




*Conclusion:* The presence/absence sequential sampling mite monitoring technique for dried plums started in 1999 with scouts monitoring a minimum of 10 trees before a decision could be made. By 2000 the technique was refined to allow a minimum of only 5 trees be monitored before a decision could be made. With an average of only three- percent defoliation and no measurable difference in fruit soluble solids over the past three years, 53 percent of the leaves with mites/eggs and predators may be the correct treatment threshold for dried plums Waiting until June to begin monitoring and waiting until 20% of the leaves had mites before increasing to a weekly sample appears too long an interval. Next season, monitoring will begin in mid-May and weekly monitoring will begin at a lower level of mite infestation.

Further evaluation of the treatment threshold will take place as more orchards have mites with defoliation at harvest. Although this monitoring technique takes too long for pest control advisors to implement the presence-absence monitoring technique for mites is a useful method of determining the need for treatment and reduces the likelihood of treating without justification.

**6. 5-Minute Search for Web spinning Mites Technique**

*Situation:* The presence-absence sampling technique for web spinning mites is a useful method of determining need for treatment and reduces likelihood of treating without justification. However, very few pest control advisors will use this technique because it is to time consuming. A "5-minute search" monitoring technique, similar to what PCA's use, was evaluated in 2001 and 2002. Results were then compared with presence-absence technique to determine if any correlation between the two could be made. No treatment decisions were made based on the new technique this past year.

*Evaluation:* The "5-minute search" monitoring technique for web spinning mites was performed in the same area of the orchard as the presence-absence technique, but the "5-minute search" was conducted first so that scouts would not be influenced results of the presence/absence technique. The new monitoring technique involved looking for symptoms of web spinning mites, as well as, looking at individual leaves with a hand lens to evaluate mite predator and web spinning mite populations. This would be done for approximately 5 minutes in two different locations in the orchard. After each 5-minute search, web spinning mite and mite predator levels were recorded. There were 6 categories for web spinning mites (none, low, low/moderate, moderate, moderate/high, high) and 3 categories for mite predators (low, moderate, high).

*Results:* The "5-minute search" monitoring technique had a 63% correlation (significant at the 99% level) with the presence-absence sampling technique in 2001 (Fig 15a) and an 84 % correlation in 2002 (Fig 15b).

**Fig 15a.**

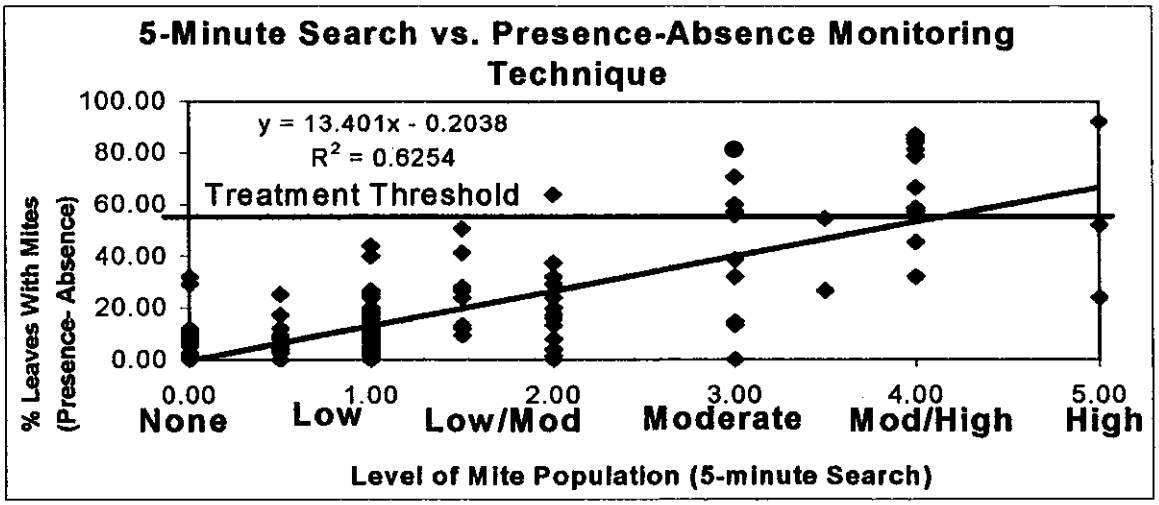
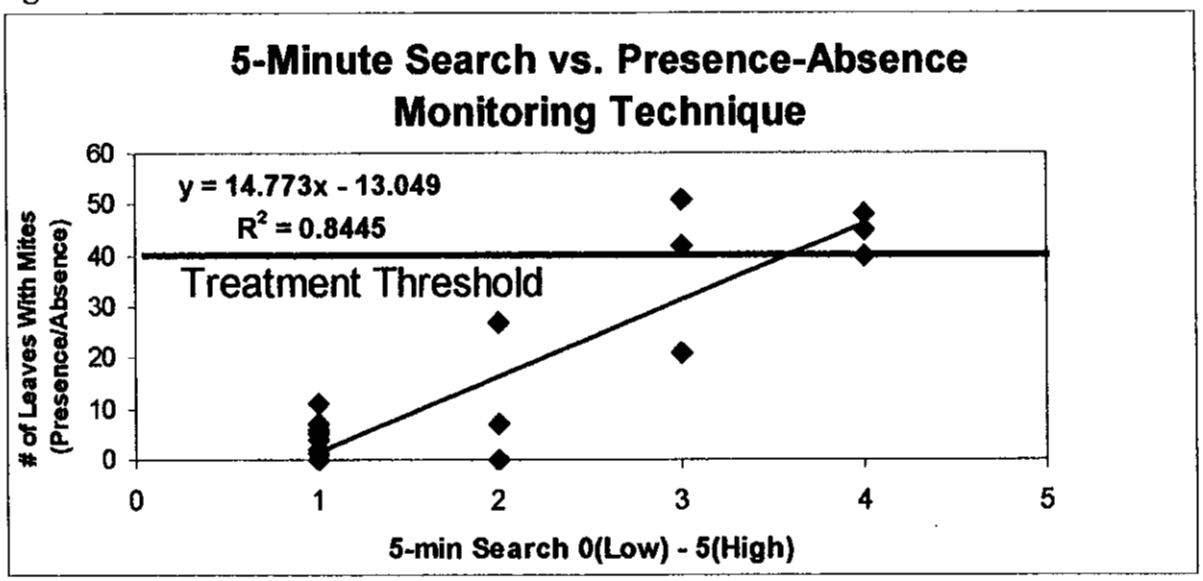


Fig 15b.




*Conclusion:* The "5-minute search" monitoring technique could be an accurate time saving monitoring technique to determine weather or not a treatment is needed for web spinning mites. The "5-minute search" requires more training and experience than presence-absence. One of the reasons that the correlation was not better in 2001 was human judgment. One person's "low" could be considered another person's moderate. Training people scouting orchards in 2002 was more extensive. The correlation line suggests that the "moderate/high) level is the treatment threshold. However "moderate" would be a better treatment threshold because it is the first level that has numerous data points above the validated treatment threshold. More research comparing these two monitoring techniques will need to be done in order to establish more accurate treatment thresholds.

**7. Fruit Brown Rot Predictive Model (ONFIT):**

*Situation:* There is currently no way of knowing if fruit brown rot will occur. Consequently growers have been spraying pre-harvest for fruit brown rot based on a suspicion that it will occur. UC Plant Pathologist Themis Michalaides has created a technique to determine presence of fruit brown rot from latent infections that needs to be validated. The technique is called Over Night Freezing/Incubation Technique (ONFIT).

*Evaluation:* ONFIT involves freezing a sample of green fruit in early June then allowing it to thaw to promote development of latent infections by *Monilinia fruticola* or *Monilinia laxa.* Levels of latent infection revealed using the ONFIT technique were correlated to levels of fruit brown rot infection that became visible in the field later in the season. This information was used to determine need to protect fruit from brown rot infection with a fungicide application.

*Results:* In 2002, it was decided to only perform the ONFIT on orchards that had bad Brown Rot problems in the past. The ONFIT was conducted on two orchards and found 1 % and 2%. At harvest no Brown Rot was found at either orchard. Results of the ONFIT procedure predicted that 52 percent of the sites in 2001 (Table 11), 21 percent in 2000 (Table 12) and 36 percent of the sites in 1999 (Table 13) had low levels of latent brown rot present. Based on ONFIT estimation (Table 10), no fungicide treatments for fruit brown rot were recommended for any of the sites. In July and again

at harvest, 1000 fruit per plot were examined for presence of brown rot infection. Results of the final field evaluations at harvest indicted that fruit brown rot was present in low levels at 43 percent of the sites in 2001, 43 percent of the sites in 2000 and 18 percent of the sites in 1999. Eight of the ten sites that had brown rot were among the twelve predicted to have brown rot using the ONFIT procedure in 2001. In 2001, brown rot levels during July exceeded 1% infection in 2 sites, while at harvest only one site exceeded 1% infected fruit (Table check number). No sites in 1999 and only one site in 2000 exceeded the 1% infected fruit level for brown rot at harvest.

**Table. 10**

| % infected green fruit[1] | % infected fruit (field) | % infected fruit (post harvest) |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 1 | 5 |
| 2 | 3 | 15 |
| 5 | 9 | 35 |
| 8 | 14 | 50 |

**Table 11. 2001 ONFIT results**

| County and Site | ONFIT Prediction (% Brown Rot) | % Brown Rot Present in July | % Brown Rot Present at Harvest |
|---|---|---|---|
| Ag - Tulare | 0 | 0.0 | 0.0 |
| BR - Glenn | 1 | 0.0 | 0.2 |
| DB - Butte | 2 | 0.3 | 0.2 |
| Br - Madera | 0 | 0.0 | 0.0 |
| GC - Sutter | 8 | 0.0 | 0.0 |
| CSUC - Butte | 0 | 0.3 | 0.0 |
| DC - Butte | 8 | 0.2 | 0.0 |
| FI - Tehama | 1 | 0.0 | 0.0 |
| EG - Fresno | 0 | 0.0 | 0.0 |
| BJ - Butte | 2 | 0.5 | 1.5 |
| JH - Sutter | 0 | 0.0 | 0.0 |
| JC - Butte | 1 | 0.7 | 0.5 |
| JT - Yolo | 0 | 0.0 | 0.0 |
| KJ - Yuba | 5 | 7.0 | 0.2 |
| LF - Glenn | 1 | 0.2 | 0.2 |
| MK - Yuba | 6 | 0.7 | 0.0 |
| AR - Tehama | 0 | 0.0 | 0.0 |
| MJ - Sutter | 2 | 1.7 | 0.0 |
| OO - Butte | 0 | 0.0 | 0.3 |
| RBF - Tehama | 0 | 0.0 | 0.2 |
| TR - Sutter | 0 | 0.0 | 0.2 |
| DV - Tulare | 0 | 0.0 | 0.0 |
| WG - Glenn | 1 | 0.0 | 0.7 |

Table 12. 2000 ONFIT Results

| County and Site | % Infected Fruit or Clusters of Fruit | | | |
|---|---|---|---|---|
| | ONFIT Prediction | Brown Rot Present at Harvest | | |
| | Reduced Risk | Reduced Risk | Conventional | Check |
| Sutter - MJ | 0 | 0 | 0 | 0.1 |
| Yuba - MK | 0 | 0 | 0 | 0 |
| Yuba - KJ | 0 | 0.3 | 0.1 | 0 |
| Sutter - GC | 0 | 0.1 | | |
| Sutter - JH | 0 | 0.1 | | |
| Butte - BJ(clan) | 0 | 0 | | |
| Butte - Harkey | 0 | 0 | 0 | 0 |
| Sutter - DC | 0 | 0.1 | 0 | 0 |
| Butte - CSUC | 0 | 0.2 | 0 | 0.3 |
| Butte - DB | 0 | 0.1 | | |
| Glenn - WG | 0 | 0.1 | 0 | 0 |
| Tehema - D.E. | 0 | 0 | | |
| Tehema - R.B.F. | 0 | 0 | 0 | 0 |
| Tehema - Mo | 1 | 0 | 0 | 0 |
| Tehema - V.D. | 0 | 0 | 0 | 0 |
| Butte - Ons | 3 | 0.1 | 0 | 0.1 |
| Butte - K.L. | 2 | 0 | | |
| Madera - Br | 0 | 0 | 0 | 0 |
| Fresno - Ak | 0 | 0 | 0 | 0 |
| Tulare - Ag | 0 | 0 | 0 | 0 |
| Sutter - JR.T. | 1 | 0.1 | | |
| Glenn - M.B. | 1 | 1.7 | 0.1 | 0.4 |
| T.B. - Merced | 0 | 0 | 0 | 0 |
| Yolo - JT | 0 | 0 | 0 | 0 |

**Table 13. 1999 ONFIT Results**

| County and Site | ONFIT Prediction % BR | % Brown Rot Present at Harvest | | |
|---|---|---|---|---|
| | ESPS | ESPS | CONV | CHECK |
| Butte - CS | 0.0 | 0.2 | 0.0 | 0.0 |
| Yuba - KJ | 0.0 | 0.0 | 0.0 | 0.0 |
| Yuba - MP | 1.0 | 0.0 | 0.0 | 0.0 |
| Butte - BJ | 1.0 | 0.0 | 0.0 | 0.0 |
| Sutter - MJ | 0.0 | 0.0 | 0.0 | 0.0 |
| Sutter - DC | 0.0 | 0.0 | 0.0 | 0.0 |
| Sutter - GC | 1.0 | 0.0 | 0.0 | 0.0 |
| Sutter - JH | 0.0 | 0.0 | 0.0 | 0.0 |
| Tehama - VM | 0.0 | 0.0 | 0.0 | 0.0 |
| Tehama - RB | 0.0 | 0.0 | 0.0 | 0.0 |
| Glenn - WG | 0.0 | 0.1 | 0.0 | 0.0 |
| Yolo - JT | 0.0 | 0.0 | 0.0 | 0.0 |
| Merced - GL | 0.0 | 0.0 | 0.0 | 0.0 |
| Merced - TB | 0.0 | 0.0 | 0.0 | 0.0 |
| Fresno - CB | 0.0 | 0.0 | 0.0 | 0.0 |
| Tulare - DA | 0.0 | 0.5 | 0.0 | 0.0 |
| Madera - ST | 0.0 | 0.0 | 0.0 | 0.0 |
| Glenn - B | 1.0 | 0.0 | 0.0 | 0.0 |
| Butte - OO | 4.0 | 0.0 | 0.0 | 0.0 |
| Tehama - FM | 2.0 | 0.0 | 0.0 | 0.0 |
| Tehama - SV | 5.0 | 0.0 | 0.0 | 0.0 |
| Sutter - TR | 6.0 | 0.1 | 0.4 | 0.9 |

*Conclusion:* The ONFIT technique needs to be evaluated under more severe conditions before it can be relied upon. Under the current conditions of little or no fruit brown rot, the ONFIT test was 67 % accurate in predicting whether or not the orchard would have some level of brown rot in 2001. Although this % accuracy may seem low, it is surprisingly high for so little brown rot found at harvest. However in 2000 the % accuracy was only 12.5 % and in 1999 it was 4.5 %. This monitoring technique could provide valuable guidance about the need for a fruit brown rot spray. More research and evaluation of the ONFIT during years of higher brown rot will need to be conducted before any definite conclusions can be made.

## II. More Effective Use of Fertilizers and Natural Resources

### 1. Using tissue analysis and water samples

*Situation:* Although tissue analysis has been recommended for many years it is an underutilized tool in determining fertilization needs. Water analyses are also valuable; some wells have nitrate nitrogen in their water. Knowledge of N content of the water could be used by growers to supplement conventional N fertilizer programs. For adoption of these monitoring tools, their utility needs to be documented and demonstrated to growers.

*Evaluation:* Plant tissue and water samples for each site for each project year were collected in July. Results from the samples were reported to growers for their consideration when making decisions on fertilizer applications in the reduced risk plots. In 2002 water samples were only collected from wells

that had high $NO_3$-N in the past.

*Results:* Results of water analyses are shown in Tables 14a and 14b and tissue analyses in Tables 15-18. By multiplying ppm of $NO_3$-N by 2.72 you obtain lbs of N/acre ft of water applied. Sites highlighted in Table 14 have a high amount of $NO_3$-N in the water

Levels of Nitrogen, Potassium (K), Zinc (Zn) and Boron (B) were obtained through tissue analysis. Deficient levels of the nutrients are as follows: Nitrogen – less than 2.2 percent, Potassium – less than 1.3 percent, Zinc – less than 18 ppm, and Boron – less than 30 ppm. Boron is also toxic if the levels in the tissue exceed 100 ppm.

**Table 14a. Water Analysis (2002)**

| Grower | N03 - ppm | Lbs of N/Acre ft of Water Applied |
|---|---|---|
| Ag - Tulare | 7.7 | 20.94 |
| Vo - Tulare | 5.5 | 14.96 |
| D.B. - Butte | 5.4 | 14.69 |
| K.J. - Yuba | 0.3 | 0.82 |
| CSUC - Butte | 5.2 | 14.14 |
| RBF - Tehama | 3 | 8.16 |

Table 14b. Water Analysis (1999-2001)

| 2001 | | | 2000 | | 1999 | |
|---|---|---|---|---|---|---|
| Grower | NO3 - ppm | Lbs N/acre ft water | NO3 - ppm | Lbs N/acre ft water | NO3 - ppm | Lbs N/acre ft water |
| Ag - Tulare(north) | 2.1 | 5.8 | 2.3 | 6.1 | 2.4 | 6.4 |
| **Ag - Tulare(south)** | **7.2** | **19.5** | **10.1** | **27.4** | **10.1** | **27.5** |
| **CSUC - Butte** | **4.8** | **13.1** | **3.2** | **8.6** | **5.7** | **15.5** |
| D.B. - Butte | 8.0 | 21.8 | 5.2 | 14.2 | | |
| D.E. - Tehama | 1.7 | 4.6 | 1.7 | 4.5 | 6.1 | 16.5 |
| **Harkey - Butte** | **15.2** | **41.3** | **10.4** | **28.3** | **10.5** | **28.6** |
| **JH - Sutter** | **25.2** | **68.5** | **3.4** | **9.1** | **5.9** | **16.0** |
| KJ - Yuba | 1.2 | 3.3 | 1.6 | 4.4 | 1.7 | 4.7 |
| **MJ - Sutter** | **9.6** | **26.1** | **8.5** | **23.1** | **8.2** | **22.2** |
| MK - Yuba | 2.2 | 6.0 | 2.6 | 7.1 | 1.8 | 4.8 |
| RBF - Tehama | 0.8 | 2.2 | 2.7 | 7.4 | 2.1 | 5.7 |
| DV - Tulare | 3.6 | 9.7 | 2.1 | 5.7 | 2.1 | 5.7 |
| **EG - Fresno (BP)** | **3.9** | **10.6** | **8.3** | **22.6** | **5.2** | **14.1** |
| **EG - Fresno (RP)** | **8.2** | **22.3** | <.05 | <.135 | <.05 | 0 |
| Br - Madera | 2.7 | 7.3 | <.05 | <.135 | 0.1 | 0.2 |
| D.C. - Sutter/Butte | | | 1.0 | 2.8 | 1.3 | 3.5 |
| K.L. - Butte | 0.7 | 1.9 | 1.5 | 4.2 | | |
| OO - Butte | 0.2 | 0.5 | | | <0.05 | 0 |
| **TR - Sutter** | **10.8** | **29.4** | | | **11** | **30** |
| J.T. – Yolo | | | 6.1 | 16.6 | 6 | 17 |

Table 15. 2002 Tissue Analyses for Various Nutrients

| Grower | N - % | K - % | Zn - ppm | B - ppm |
|---|---|---|---|---|
| Ag - Tulare (Con) | 2.42 | 2.43 | 20 | 67 |
| Ag - Tulare (RR) | 2.17 | 2.32 | 13 | 60 |
| M.B. - (Con) | 2.08 | 2.64 | 16 | 60 |
| M.B. (RR) | 2.23 | 2.37 | 18 | 59 |
| D.B. - Butte | 2.34 | 2.61 | 20 | 58 |
| B.F. - Butte | 2.32 | 1.92 | 18 | 42 |
| M.C. - Butte | 2.25 | 2.55 | 45 | 52 |
| CSUC - Butte | 1.95 | 2.6 | 18 | 59 |
| L.L. - Butte | 2.34 | 2.21 | 23 | 43 |
| D.Brs. - Butte | 2.34 | 3.05 | 20 | 63 |
| J.L. - Butte | 2.34 | 3.02 | 45 | 44 |
| E.G. - Fresno (Con) | 2.3 | 3.24 | 17 | 66 |
| E.G. - Fresno (RR) | 2.24 | 3.01 | 18 | 67 |
| P.H. - Butte | 2.48 | 3.2 | 23 | 44 |
| K.J. - Yuba (Check) | 2.64 | 0.98 | 27 | 45 |
| K.J. - Yuba (Con) | 2.24 | 1.89 | 23 | 38 |
| K.J. - Yuba (RR) | 2.39 | 1.8 | 23 | 38 |
| B.J. - Butte | 2.35 | 3.05 | 20 | 56 |
| G.L. - Butte | 2.24 | 1.97 | 16 | 47 |
| M.F. - Butte | 2.08 | 2.34 | 14 | 45 |
| A.R. - Tehama (RR) | 2.55 | 2.4 | 18 | 59 |
| O.O. - Butte (Con) | 2.3 | 3 | 20 | 58 |
| O.O. - Butte (RR) | 2.06 | 2.96 | 21 | 57 |
| L.P. - Butte | 2.5 | 2.91 | 21 | 47 |
| RBF - Tehama (RR) | 2.97 | 3.12 | 25 | 98 |
| D.V. - Tulare (Con) | 2.8 | 2.59 | 15 | 56 |
| D.V. - Tulare (RR) | 2.05 | 3.25 | 12 | 64 |

**Table 16. 2001 Tissue Analyses for Various Nutrients**

| Grower | N -% | K - % | B - ppm | Zn - ppm |
|---|---|---|---|---|
| Ag - Tulare (Con) | 2.34 | 2.36 | 62 | 14 |
| Ag - Tulare(RR) | 2.2 | 2.7 | 69 | 12 |
| BR - Glenn | 2.2 | 2.4 | 54 | 11 |
| DB - Butte | 1.7 | 2.6 | 59 | 60 |
| Br - Madera | 2.1 | 3.2 | 69 | 17 |
| GC - Sutter | 1.7 | 2.3 | 62 | 21 |
| CSUC - Butte (CON) | 2.3 | 2.4 | 49 | 21 |
| CSUC - Butte (RR) | 2.4 | 3.4 | 49 | 23 |
| DC - Butte (CON) | 1.9 | 3.0 | 52 | 23 |
| DC - Butte (RR) | 1.9 | 2.6 | 53 | 21 |
| FI - Tehama | 2.4 | 3.0 | 39 | 20 |
| EG - Fresno (Con) | 2.2 | 3.6 | 72 | 18 |
| EG - Fresno (RR) | 2.3 | 3.5 | 77 | 18 |
| BJ - Butte (CON) | 2.0 | 2.4 | 52 | 26 |
| BJ - Butte (RR) | 1.8 | 3.4 | 49 | 35 |
| JH - Sutter | 1.8 | 2.1 | 48 | 20 |
| JT - Yolo (RR) | 2.5 | 2.7 | 66 | 70 |
| JT - Yolo (Con) | 2.5 | 2.3 | 61 | 56 |
| KJ - Yuba (CON) | 2.5 | 2.2 | 51 | 24 |
| KJ - Yuba (RR) | 2.3 | 2.1 | 52 | 21 |
| JC - Butte | 2.1 | 2.7 | 58 | 19 |
| LF - Glenn | 2.0 | 2.5 | 59 | 18 |
| MK - Yuba | 2.0 | 2.1 | 39 | 18 |
| AR - Tehama(Con) | 2.6 | 4.4 | 76 | 20 |
| AR - Tehama (RR) | 2.4 | 3.4 | 72 | 18 |
| MJ - Sutter (CON) | 2.0 | 2.4 | 54 | 16 |
| MJ - Sutter (RR) | 2.0 | 2.9 | 57 | 16 |
| OO - Butte | 2.3 | 3.0 | 52 | 24 |
| RBF - Tehama (Con) | 2.8 | 4.1 | 91 | 38 |
| RBF - Tehama (RR) | 2.8 | 4.3 | 88 | 24 |
| TR - Sutter | 2.2 | 2.4 | 46 | 18 |
| DV - Tulare (Con) | 2.4 | 2.9 | 69 | 15 |
| DV - Tulare (RR) | 2.0 | 3.2 | 65 | 16 |

**Table 17. 2000 Leaf Tissue Analysis**

| Grower/Orchard - County | N - % | K- % | B ppm | Zn ppm |
|---|---|---|---|---|
| D.E. - Tehama | 3.0 | 4.0 | 51 | 23 |
| K.L.- Butte | 2.7 | 2.7 | 61 | 24 |
| JR. T. - Sutter | 2.7 | 2.8 | 47 | 20 |
| J.H. - Sutter | 2.4 | 2.5 | 50 | 13 |
| Ons - Butte | 2.5 | 3.1 | 58 | 19 |
| B.J. (clan) - Butte | 2.6 | 2.3 | 44 | 21 |
| M.K. - Yuba | 2.3 | 1.6 | 31 | 14 |
| G.C. - Sutter | 1.9 | 1.8 | 33 | 13 |
| K.J. - (Reduced Risk) | 2.4 | 1.2 | 35 | 23 |
| K.J. - (conv.) | 2.5 | 1.2 | 34 | 19 |
| M.B. - Glenn | 1.9 | 1.9 | 47 | 17 |
| D.B. - Butte | 2.3 | 1.9 | 46 | 14 |
| CSU (Reduced Risk) - Butte | 2.6 | 2.1 | 49 | 17 |
| CSU (conv.) - Butte | 2.6 | 2.7 | 52 | 19 |
| Harkey (Reduced Risk) - Butte | 2.5 | 1.8 | 40 | 13 |
| Harkey (Conv.) - Butte | 2.3 | 1.9 | 39 | 12 |
| M.J. (conv.) - Sutter | 2.4 | 1.6 | 43 | 11 |
| M.J. (Reduced Risk) - Sutter | 2.3 | 1.8 | 37 | 13 |
| D.C. (Reduced Risk) - Sutter | 2.4 | 1.4 | 37 | 14 |
| D.C. (conv.) - Sutter | 2.1 | 1.4 | 38 | 13 |
| V.D. - Tehama | 2.6 | 3.9 | 80 | 13 |
| Mo. - Tehama | 2.8 | 3.6 | 81 | 16 |
| R.B.F. - Tehama | 2.5 | 4.0 | 111 | 203 |
| Br. - Madera | 2.4 | 3.8 | 76 | 30 |
| Ak (Con) - Fresno | 2.8 | 3.4 | 81 | 137 |
| Ak (Reduced Risk) - Fresno | 2.4 | 3.9 | 87 | 185 |
| DA (Conv) - Tulare | 2.6 | 3.0 | 84 | 73 |
| DA (Reduced Risk) - Tulare | 2.7 | 3.2 | 70 | 69 |
| DA (Check) - Tulare | 2.6 | 2.5 | 67 | 30 |
| J. T. (Reduced Risk) - Yolo | 2.6 | 2.2 | 53 | 57 |
| J. T. (conv) - Yolo | 2.9 | 2.2 | 55 | 62 |
| W.G. (Reduced Risk) - Glenn | 2.2 | 2.8 | 47 | 25 |
| W.G. (Conv) - Glenn | 2.4 | 3.0 | 50 | 309 |
| W.G. (Check) - Glenn | 2.1 | 2.8 | 49 | 18 |
| T.B. (Conv) - Merced | 2.6 | 2.3 | 52 | 9 |
| T.B. (Reduced Risk) - Merced | 2.4 | 2.6 | 52 | 13 |
| Gr. (Reduced Risk) - Merced | 2.6 | 2.1 | 66 | 12 |
| Gr. (Conv) - Merced | 2.7 | 1.8 | 56 | 13 |

**Table 18. 1999 Leaf Tissue Analysis**

| County & ID | Treatment | N-Total (%) | K-Total (%) | B (ppm) | Zn (ppm) |
|---|---|---|---|---|---|
| Butte-BJ | Conv. | 2.3 | 2.3 | 44 | 178 |
| Butte-BJ | ESPS | 2.2 | 2.2 | 44 | 160 |
| Butte-CSUC | Overall | 2.6 | 3.2 | 66 | 27 |
| Butte-OO | Overall | 2.0 | 3.6 | 60 | 22 |
| Glenn-B | Overall | 2.5 | 3.4 | 71 | 165 |
| Glenn-WG | Conv. | 2.6 | 3.6 | 58 | 93 |
| Glenn-WG | ESPS | 2.3 | 2.7 | 54 | 36 |
| Merced-GL | Conv. | 2.9 | 2.2 | 66 | 21 |
| Merced-GL | ESPS | 2.5 | 3.2 | 80 | 17 |
| Merced-TB | Conv. | 2.4 | 2.7 | 47 | 17 |
| Merced-TB | ESPS | 2.7 | 2.1 | 55 | 182 |
| Sutter-DC | Overall | 2.3 | 2.3 | 48 | 18 |
| Sutter-GC | Overall | 2.2 | 2.5 | 52 | 19 |
| Sutter-JH | Overall | 2.4 | 2.3 | 45 | 16 |
| Sutter-MJ | Overall | 2.2 | 3.9 | 61 | 14 |
| Sutter-TR | Overall | 2.4 | 2.1 | 58 | 88 |
| Tehama-F | Overall | 2.2 | 4.1 | 46 | 20 |
| Tehama-M | Conv. | 2.4 | 2.9 | 73 | 263 |
| Tehama-M | ESPS | 2.6 | 2.5 | 73 | 26 |
| Tehama-RB | Conv. | 2.5 | 3.3 | 102 | 194 |
| Tehama-RB | ESPS | 2.7 | 3.4 | 106 | 231 |
| Tehama-SV | Overall | 2.7 | 3.7 | 71 | 231 |
| Tulare-A | Conv. | 2.6 | 3.2 | 59 | 70 |
| Tulare-A | ESPS | 2.5 | 2.3 | 51 | 33 |
| Tulare-A | Check | 2.5 | 2.0 | 57 | 30 |
| Yolo-T | Conv. | 3.4 | 1.8 | 46 | 51 |
| Yolo-T | ESPS | 2.5 | 2.2 | 51 | 50 |
| Yolo-T | Check | 2.5 | 2.1 | 52 | 47 |
| Yuba- KJ | Overall | 2.3 | 2.9 | 57 | 36 |
| Yuba-M | Overall | 2.2 | 3.4 | 47 | 18 |

*Conclusion:* Based on U.C. established critical mid-summer leaf tissue levels, almost half of the sites in 2001 were deficient in N and a few sites had zinc levels below the recommended level. Nitrogen levels had declined since 1999. In 1999, 20 percent of the sites were N deficient, in 2000 five percent of the sites were N deficient and in 2001 48.5 percent of the sites were N deficient. The advisors involved at these sites have been working with their cooperators to determine fertilizer strategies based on these data. In 2002 only 20 % of the sites were deficient in Nitrogen. This could be an indication of the advisors and cooperators working together to come up with better Nitrogen fertilization programs. Water samples did indicate several wells with significant levels of nitrate nitrogen. The high nitrate levels were considered when making fertilizer recommendations in the reduced risk plots. These tissue and water analysis have provided useful information and are proving to be valuable tools.

## 2. Early leaf analysis to forecast the need of a Potassium (K) fertilizer application:

*Situation:* Established guidelines for adequate leaf K levels in dried plums are available using July leaf tissue samples. However, if a deficiency is present at that time, detrimental effects to production of the crop may have already occurred. Limited research has been done on using early leaf tissue samples to predict the need for potassium applications. In 2001 and 2002 the early leaf tissue sampling for K was compared to the July leaf sample in all of the research and implementation orchards. In 2002 Nitrogen was also tested and compared along with Potassium.

*Evaluation:* One hundred fully expanded, mature leaves from at least 25 healthy trees were collected in the first week of May and tested for K content. Using previous research data, K fertilizer recommendations were used based on the May sample. The recommendations were: If over 2% there should be no need to apply K. If 1.5% to 2.0% leaf K is found, depending upon crop load, there may be no need to apply K. If 1.3% to 1.5% leaf K, observe tree appearance and crop load, and consider K applications to keep leaf K levels stable. If below 1.3 % K, then applications should be considered. For Nitrogen (N) if the % N is below 2.3 % then Nitrogen fertilizer is needed. If over 2.8 %, there should be no need to apply N. If there is 2.3 to 2.7% leaf Nitrogen (N) observe the appearance of the trees and crop load, and consider N applications to keep leaf N levels stable. Try to maintain levels through the season between 2.2 % and 2.8% leaf N.
The goal was to compare the early leaf K readings to the July leaf K readings in order to determine if you can predict leaf K status in July from early leaf K readings in May. By being able to predict K levels early on, fertilizers could be used to treat K deficiencies that would have a much larger detrimental effect later in the season. In 2002, the goal was expanded to include Nitrogen.

Once in June, July and August, trees in the reduced risk and conventional plots were monitored for the presence of K deficiency symptoms.

*Results:* In 2002, the early leaf sample found 2 orchards needing to apply Potassium and Nitrogen, 1 orchard needing to apply Nitrogen only and 1 orchard needing to apply potassium only. Two sites showed visible K deficiency symptoms in July and August (Table 18). Both sites are on heavy clay soil and had an above average crop load. Based on the early leaf tissue samples taken in May of 2001, no fertilizer applications were recommended and no sites were found deficient in leaf K in July (Table 18). Also, no sites showed any visual symptoms of K deficiency in June. However, 2 sites in July and 11 sites in August had visual symptoms of K deficiency (Table 19).

Table 18. 2002

| | Leaf Nitrogen | | Leaf Potassium | | Visual Inspection: Estimated % Trees with K | | |
|---|---|---|---|---|---|---|---|
| | May | July | May | July | | | |
| Orchard | % N | % N | % K | % K | June | July | August |
| Ag - Tulare (Con) | 2.81 | 2.42 | 1.57 | 2.43 | 0 | 0 | 0 |
| Ag - Tulare (RR) | 2.58 | 2.17 | 1.88 | 2.32 | 0 | 0 | 0 |
| M.B. - (Con) | 2.72 | 2.08 | 2.1 | 2.64 | 0 | 0 | 0 |
| M.B. (RR) | 2.72 | 2.23 | 2.1 | 2.37 | 0 | 0 | 0 |
| D.B. - Butte | 2.8 | 2.34 | 2.06 | 2.61 | 0 | 0 | 0 |
| B.F. - Butte | 2.6 | 2.32 | 1.83 | 1.92 | 0 | 0 | 0 |
| M.C. - Butte | 1.7 | 2.25 | 0.65 | 2.55 | 0 | 0 | 0 |
| L.L. - Butte | 2.52 | 2.34 | 2.01 | 2.21 | 0 | 15 | 40 |
| D.Brs. - Butte | 2.76 | 2.34 | 2.04 | 3.05 | 0 | 0 | 0 |
| J.L. - Butte | 3.28 | 2.34 | 2.72 | 3.02 | 0 | 0 | 0 |
| E.G. - Fresno (Con) | 2.58 | 2.3 | 2.82 | 3.24 | 0 | 0 | 0 |
| E.G. - Fresno (RR) | 2.5 | 2.24 | 2.7 | 3.01 | 0 | 0 | 0 |
| P.H. - Butte | 2.84 | 2.48 | 2.36 | 3.2 | 0 | 0 | 0 |
| K.J. - Yuba (Con) | 3 | 2.24 | 1.16 | 1.89 | 0 | 10 | 25 |
| K.J. - Yuba (RR) | 3 | 2.39 | 1.61 | 1.8 | 0 | 10 | 25 |
| B.J. - Butte | 2.64 | 2.35 | 2.39 | 3.05 | 0 | 0 | 0 |
| G.L. - Butte | 2.84 | 2.24 | 1.62 | 1.97 | 0 | 0 | 0 |
| M.F. - Butte | 2.72 | 2.08 | 2.31 | 2.34 | 0 | 0 | 0 |
| A.R. - Tehama (RR) | 2.28 | 2.55 | 2.03 | 2.4 | 0 | 0 | 0 |
| O.O. - Butte (RR) | 1.6 | 2.06 | 0.59 | 2.96 | 0 | 0 | 0 |
| L.P. - Butte | 2.56 | 2.5 | 2.45 | 2.91 | 0 | 0 | 0 |
| RBF - Tehama (RR) | 2.92 | 2.97 | 2.16 | 3.12 | 0 | 0 | 0 |
| D.V. - Tulare (Con) | 2.82 | 2.8 | 2.19 | 2.59 | 0 | 0 | 0 |
| D.V. - Tulare (RR) | 2.18 | 2.05 | 2,21 | 3.25 | 0 | 0 | 0 |

Table 19. 2001

| | Leaf K | | Visual Inspection Estimated % trees in the plot with K Deficiency | | |
|---|---|---|---|---|---|
| | May | July | Reduced Risk | | |
| Orchard | % K | % K | June | July | August |
| Ag - Tulare | 2.7 | 2.7 | 0 | 0 | 0 |
| BR - Glenn | 2.2 | 2.4 | 0 | 0 | 0 |
| DB - Butte | 2.1 | 2.6 | 0 | 0 | 10 |
| Br - Madera | 3.5 | 3.2 | 0 | 0 | 0 |
| GC - Sutter | 2.1 | 2.3 | 0 | 0 | 20 |
| DC - Butte | 2.5 | 3.4 | 0 | 5 | 15 |
| CSUC - Butte | 2.3 | 2.6 | 0 | 0 | 60 |
| FI - Tehama | 2.9 | 3.0 | 0 | 0 | 0 |
| EG - Fresno | 3.8 | 3.5 | 0 | 0 | 0 |
| BJ - Butte | 1.9 | 3.4 | 0 | 0 | 15 |
| JH - Sutter | 2.7 | 2.1 | 0 | 0 | 5 |
| JT - Yolo | 2.5 | 2.7 | 0 | 0 | 0 |
| KJ - Yuba | 1.9 | 2.1 | 0 | 10 | 20 |
| JC - Butte | 2.0 | 2.7 | 0 | 0 | 10 |
| LF - Glenn | 2.5 | 2.5 | 0 | 0 | 10 |
| MK - Yuba | 1.8 | 2.1 | 0 | 0 | 25 |
| AR - Tehama | 2.6 | 3.4 | 0 | 0 | 0 |
| MJ - Sutter | 2.3 | 2.9 | 0 | 0 | 30 |
| OO - Butte | 2.3 | 3.0 | 0 | 0 | 0 |
| RBF - Tehama | 2.3 | 4.3 | 0 | 0 | 0 |
| TR - Sutter | 2.3 | 2.4 | 0 | 0 | 0 |
| DV - Tulare | 3.0 | 3.2 | 0 | 0 | 0 |

*Conclusion:* Results from this trial are still inconclusive. More research will be needed in orchards that have deficient leaf K levels before any conclusions can be drawn.

**3. Irrigation management**:

*Situation:* Irrigation requirements of fully canopied orchards have been determined for stone fruits. It is generally assumed these requirements also apply to dried plums. However, previous research has determined that reducing irrigation (typically 40%) in mid-season, allowing mild stress to occur has no economic effect on production and quality. Reducing irrigation saves money and water, reduces pesticide runoff and results in a lower dry away ratio. In order to achieve the goal of reduced irrigation and maximum economic productivity, we utilized a monitoring technique that determines tree-water status (midday stem water potential or SWP) and evaluates stress. We determined the midday SWP by using a "pump up" pressure chamber. A plastic/foil envelope is used to cover a lower canopy leaf that is close to the trunk or a main scaffold. The bagged leaf must remain on the tree for at least 10 minutes. The bagged leaf is then placed in the chamber with only the petiole sticking out. Air is forced into the chamber by pumping the device up and down (similar to a tire pump) until water is forced out of the petiole. The amount of pressure that it took to force the water out of the leaf is measured in bars. The amount of bars it took to force the water out of the leaf is the tree's SWP.

*Evaluation*: Based on results of 2001, recommended leaf--bagging duration was reduced to a minimum of 10 minutes, but recommended sampling time for SWP continued to be at midday, between 1:00 pm and 3:00 pm (daylight savings time). In most cases a sample of 10 trees were used for orchard monitoring approximately weekly. Irrigation was only recommended when SWP reached the target values as shown in table 19.

**Table 19. Reduced risk irrigation target values over the growing season for midday stem water potential (bars).**

| Period | Month | | | | | | |
|---|---|---|---|---|---|---|---|
| | March | April | May | June | July | August | September |
| Early- | -6 | -8 | -9 | -10 | -12 | -13 | -14 |
| Mid- | -7 | -8 | -9 | -11 | -12 | -13 | -15 |
| Late- | -7 | -9 | -10 | -11 | -12 | -14 | -15 |

*Results*: Five of the sites have historically involved a comparison between conventional irrigation management and reduced risk irrigation management. At most of these sites however, growers are recognizing benefits of the reduced risk program, and have adopted a reduced risk approach to irrigation in the conventional blocks. As a result, there were only minor differences between these comparison treatments in the 2001 season, with SWP in both treatments approximating the recommended reduced risk SWP target values (Fig 16). For the other monitored sites we generally observed a good match between the observed and the target SWP, but there was some grower-to-grower variation (Figs 17 and 18).

**Fig 16. Midday Stem Water Potential**

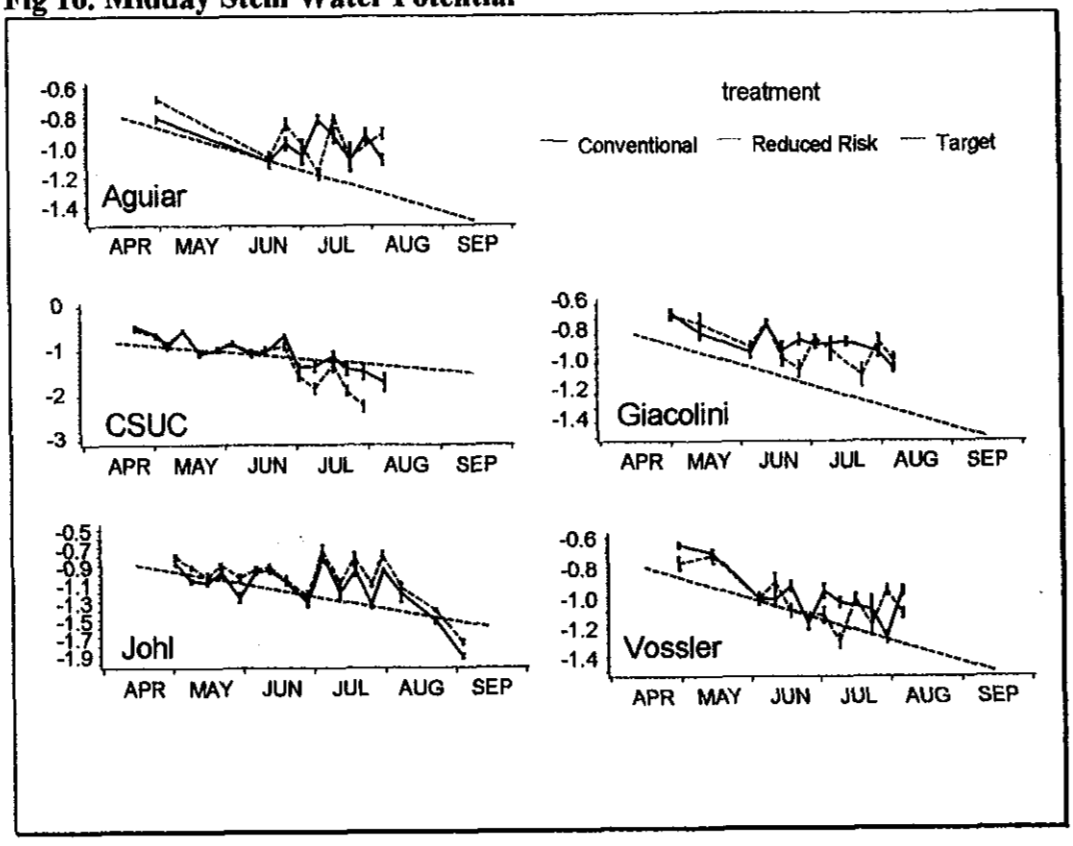



**Fig17. Midday Stem Water Potential**

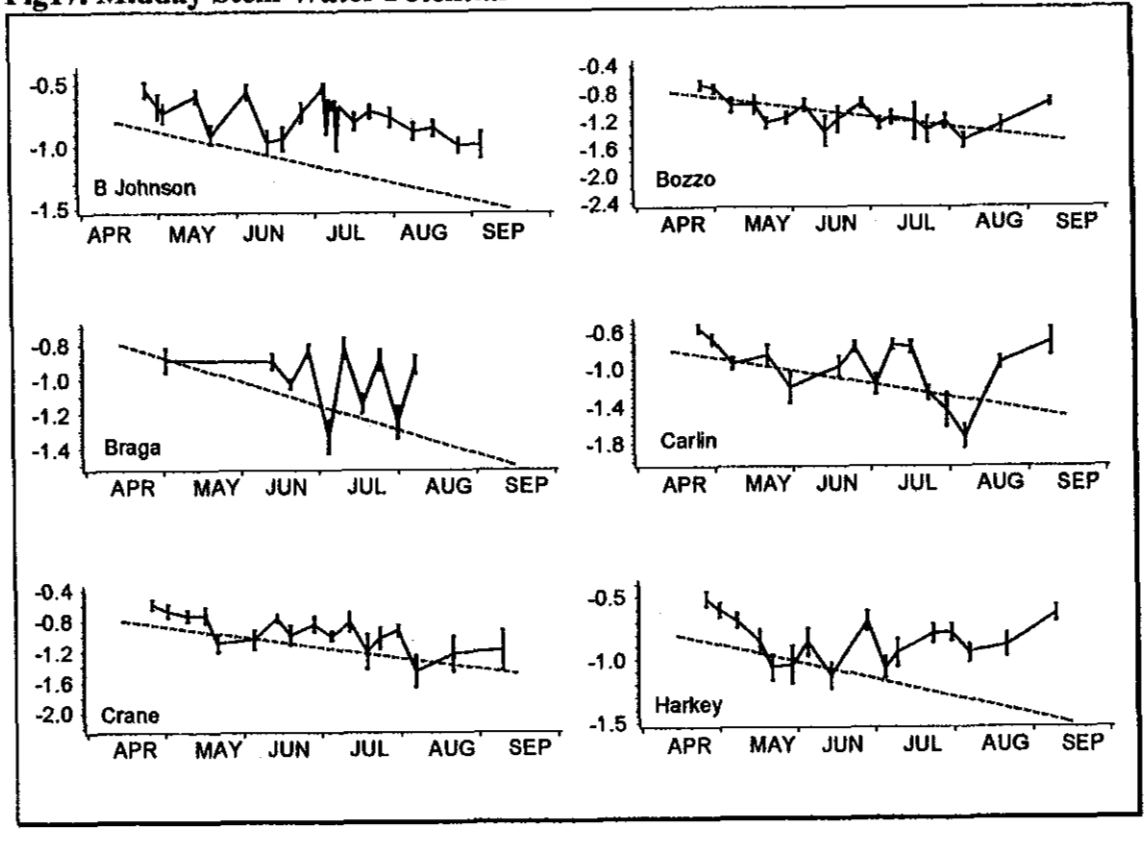
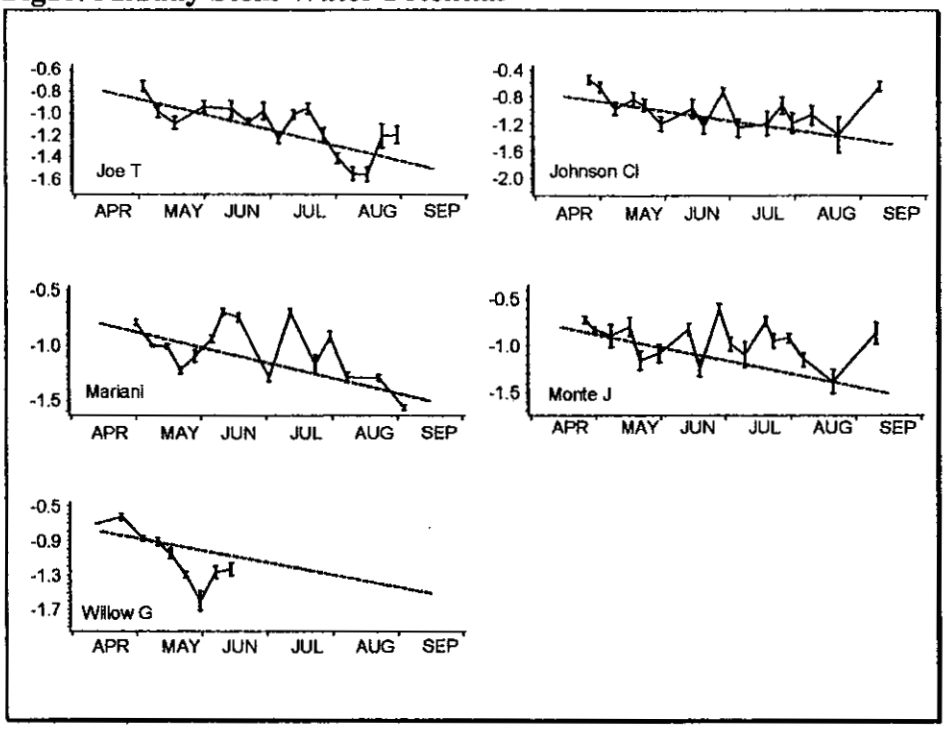


**Fig18. Midday Stem Water Potential**




*Conclusion*: Most growers who began with comparison plots of reduced risk and conventional irrigation have adopted the reduced risk irrigation monitoring strategy on their conventional blocks, indicating they have recognized benefits of this approach to irrigation scheduling. Other growers have reported unanticipated horticultural benefits of this practice, for instance the suppression of an undesirable and often chlorotic flush of shoot growth in the fall, presumably the result of over-irrigation. The fact that many growers have matched the reduced risk target SWP over the season indicates that the reduced risk monitoring technique is practical and achievable over a range of soil and orchard conditions.

This part of the project has become increasingly popular with growers because using the pressure chamber to schedule irrigations can save potentially save them money by applying less water.

**4. Quality and harvest evaluation:**

In 1999 and 2000, quality data were obtained from growers' P-1 grade sheets. However, these grade sheets were difficult to obtain from the grower, made harvesting for the grower more complicated and lumped disease and insect data together. In 2001 and 2002, the Dried Fruit Association (DFA) provided quality analysis from harvest samples taken from each plot. There were no significant differences between any of the treatments (Reduced Risk, Conventional, and Check) in soluble solids, dry count per pound or dry away ratio (Tables 19-21). In terms of quality, there were no significant differences between the Reduced Risk and Conventional plots for % ABC screen, total % ABC off-grade, % ABC off-grade due to cracks, splits, etc... or % ABC off-grade due to insects and/or disease (Tables 19-22).

**Table 19.**

| Mean 2002 Harvest and Quality Data | | | | | | | |
|---|---|---|---|---|---|---|---|
| | S.S. | Dry Ct./ lb. | Dry Away Ratio | % ABC Screen | Total % ABC Offgrade | % ABC Offgrade due to Cracks/splits etc.. | % ABC Offgrade due to disease/insects |
| Reduced Risk | 20.8 | 51.4 | 3.0 | 93.2 | 7.2 | 3.7 | 1.8 |
| Conventional | 19.7 | 53.8 | 3.1 | 89.9 | 9.3 | 5.5 | 2.3 |

No significant difference at the 95% level of confidence according to Duncan's Multiple Range Test for Mean Separation.

**Table 20.**

| Mean 2001 Harvest and Quality Data | | | | | | | |
|---|---|---|---|---|---|---|---|
| | S.S. | Dry Ct./ lb. | Dry Away Ratio | % ABC Screen | Total % ABC Offgrade | % ABC Offgrade due to Cracks/splits etc.. | % ABC Offgrade due to disease/insects |
| Reduced Risk | 23.9 | 62.7 | 2.9 | 81.0 | 7.2 | 5.5 | 0.5 |
| Conventional | 24.5 | 63.1 | 3.0 | 81.5 | 5.5 | 4.0 | 0.6 |
| Check | 23.5 | 55.3 | 2.8 | 87.4 | 8.4 | 6.3 | 0.5 |

No significant difference at the 95% level of confidence according to Duncan's Multiple Range Test for Mean Separation.

**Table 21.**

| 2000 P-1 Grade Sheet Analysis | | | | | |
|---|---|---|---|---|---|
| | Yield (lbs/acre) | Average Count per Pound | Dry Away | % ABC screen | % ABC Offgrade screen |
| Reduced Risk | 4903.07 | 57.50 | 3.22 | 91.60 | 1.54 |
| Conventional | 5139.39 | 58.80 | 2.99 | 91.52 | 1.26 |

No significant difference at the 95% level of confidence according to Duncan's Multiple Range Test for Mean Separation.

Table 22.

| 1999 P-1 Grade Sheet Analysis | | | | | |
|---|---|---|---|---|---|
| | Yield (lbs/acre) | Average Count per Pound | Dry Away | % ABC screen | % ABC Offgrade screen |
| Reduced Risk | 4705 | 52.5 b | 2.8 | 91.4 | 2.2 |
| Conventional | 4387 | 54.8 a | 2.8 | 90.1 | 1.1 |

Treatment means that are not followed by a common letter are significantly different from each other at the 95% level of confidence according to Duncan's Multiple Range Test for Mean Separation.

*Conclusion:* Based on data obtained from the 1999 and 2000 P-1 grade sheets, as well as 2001 quality data, no adverse affects have been seen in the reduced risk program as compared to the conventional program.

**III. Cover Crop and Hedgerow Program 1998-2002**

*Introduction*

At the beginning of the Integrated Dried plum Farming Practices Program (IPFP) many dried plum farmers were already experienced with cover crops. The California Dried Plum Board (CDPB) was an initial sponsor of The Nature Conservancy's (TNC) Biological Dried plum Systems (BPS) project that included cover crops and wildlife development. With the inclusion of the BPS project in the formation of the IPFP project through the SAREP BIFS grant, ten of the initial growers were already using cover crops on their initial IPFP acres.

Starting in 1998 the USDA Natural Resources Conservation Service (NRCS) awarded the CDPB an Environmental Quality Incentives Program (EQIP) grant, the first of three. The three years of EQIP funding allowed the IPFP to have a robust cover crop, filter strip, hedgerow, and wildlife friendly program statewide. During this time, these environmental practices were the primary feature at 28 meetings all of which were sponsored or cosponsored by the CDPB. These meetings drew in excess of 1,000 farmers, landowners, agencies, and reporters. In addition to the meetings, there was television coverage by Channel 12 News, multiple press releases announcing the meetings, 14 follow up articles in regional and statewide newspapers and magazines, including the front-page story by *California Farmer*, January 2000.

*Cover Crop/Buffer Strip Program*

A third of the IPFP growers use cover crops on their IPFP orchards as part of a normal floor management program. Their reasons include: improving water infiltration, nitrogen fixation, beneficial insect habitat, weed suppression, and establishing a durable floor for orchard operations. In spite of low price received for their crop, as a farm group, approximately 10 % of the dried plum growers in the state have perennial or annual cover crops as a normal orchard floor practice.

The EQIP program was the ideal program for the CDPB to expand the breadth of practices to include buffer strips and hedgerow plantings. The EQIP project selected eight farmers who allowed the IPFP project to plant 10 different demonstration cover crops at their dried plum orchards. These cover crop demonstration sites were then used as the focus of the meetings over the next three years,

allowing other growers to view them and the farmers who farmed them to evaluate how they performed under their management, irrigation, and soil type.

The following cover crops were demonstrated, with the first being planted outside the orchard and then the next four nontillage types being planted in order. The last five were covers that required disking and incorporation. By allowing us to plant these 10 covers, each participating grower had a mixture in their orchard that was difficult to manage and mow, and their contribution to the project is commendable.

1. Hard Fescue: Used as a filter strips and vegetated road.
2. 'Benefical Blend': A filter strip and insectary reservoir.
3. N. Z. White Clover/Trefoil: A nitrogen fixing sod/insectary.
4. 'Perennial Sod': A durable, low maintenance orchard floor and water infiltration.
5. 'Non Tillage Clover': A nitrogen fixing, mowable insectary floor.
6. 'Plowdown Legumes': A nitrogen fixing incorporated mixture of bell beans, peas and vetch.
7. 'Max Organic Builder': A soil improving incorporated mixture of oats, bell beans, peas and vetch.
8. Juan Triticale: A soil improving, weed suppressing grain.
9. Common Barley: A soil-improving, weed suppressing grain.
10. Resident Vegetation: The comparison or check of what would be in the orchard.

The CDPB partnered with CSU, Chico with the EQIP grant and planted a long-term cover crop trial at the CSU, Chico Farm as a regional demonstration. Forty perennial and 60 annual cover crops were planted in 2000 and again in 2001. These 5 by 30 foot demonstration plots have been marked and are an open walking tour for any group that wishes to view, cover crops, filter strips, CA nativegrasses, instecarties, vetch, peas, annual clovers, fenoeugreek, brassicas, phacelia, erosion grasses, cereals, and mixtures. This planting has been the site of 5 walking tour meetings so far and will be the site of a regional NRCS and RCD training workshop to be held April 25, 2002.

*Insectary Hedgerows*

The use of insectary hedgerows has been promoted by the IPFP at 6 different meetings. As part of the NRCS Cover Crop grant, a hedgerow project was also implemented with the cover crop cooperators. A total of 8 different dried plum ranches planted hedgerow habitat with signs for demonstration. Two particularly extensive plantings included a 4 times replicated planting at CSU, Chico dried plums where permanent, laminated signs informed all of the visitors to the CSU Farm tours about the hedgerow species, insects attracted and pests controlled. The second planting at Billiou Ranches in Hamilton City is a 20 acre planting of hedgerow species; Coyote Brush, Coffee Berry, Yarrow, and Deergrass with the species placed in clumps in place of missing trees. Many groups have visited this innovative planting over the past four years as an insectary plantings interspersed in the orchard. During the first year of the NRCS grant, Mary Kimball, previously of the Yolo County RCD was the featured speaker at four of our meetings.

*Wildlife Friendly Farming*

The IPFP program has supported wildlife friendly farming through the cover crop and hedgerow plantings. Four of our hedgerow plantings were specifically planted next to waterways including

Deer Creek and Gilsizer Slough to provide diversity, cover, and food for bird species. As part of the BPS project, funding was also provided to the Point Reyes Bird Observatory (PRBO) to monitor bird species richness and diversity in a dried plum orchard in Sutter County. The results were presented at the 1999 CDPB Research Conference, Anne M. King; *Avian Monitoring on the Heier Rnach: Progress Report of the 1999 Field Work.*

In addition to the field plantings and demonstrations, the CDPB IPFP program hosted along with our cosponsors, The Nature Conservancy and the Colusa County NRCS, three 'Wildlife Workshops' at the Colusa Farm and Equipment Show in 1999, 2000, and 2001. The attendance at the 2000 show exceeded 100 participants including; farmers, wildlife biologists, and Future Farmer of America students.

**IV. Encourage adoption of reduced risk practices through outreach and extension efforts.**

Starting at petal fall, scouts and PCA's visit each orchard at least once a week until harvest. Orchard info such as insect counts, disease findings, ...etc. was reported to the grower at least once per week. See attached, IPFP Research/Implementation plots, showing the growers in the IPFP Program in 2002.

Ten newsletters were published and distributed to all 1,400 dried plum growers in California plus about 500 related industry members about the progress of the project.

Meetings to share information were numerous and well attended. 1065 people in 2001, over 1,154 in 2000 and over 787 in 1999 received information at meetings on the IPFP project. Following is a list of meetings held: dates, subjects covered, location and attendance (See attached Table: IPFP Meetings) as well as a list of meetings below. Also included with the meeting material are the minutes of the IPFP Management Team meetings. In addition, the Tehama county advisor provided insect day degree accumulation to clientele via e-mail on a regular basis.

Meetings during 2002 were:

1. Orchard Dormant Spray Meeting – 153 attendance 12/5/01
2. How to Save Money on Your Dormant Spray - 84 12/6,7,8/01
3. IPFP Management Team – 13 2/14/02
4. San Joaquin Valley Dried Plum Day – 78 2/28/02
5. DPR/PMA Workshop – 30 3/12/02
6. Statewide dried plum day - 173 3/15/02
7. PCA Meeting – 8 3/27/02
8. Dried plum field scout meeting - 16 5/17/02
9. Aphid control field meeting - 29 5/20/02
10. Glenn Co. water stewardship - 46 5/22/02
11. IPFP Management Team – 11 5/29/02
12. UC/PUR – 6 6/6/02
13. Prune/PUR – 9 6/7/02
14. 3rd orchard field day - 90 6/27/02
15. Tree fruit pest management - 33 9/5/02
16. IPFP Management Team – 13 11/26/02
17. Orchard dormant spray meeting - 37 12/5/02

IPFP Newsletters are attached and were sent out:

1. April #123
2. May #121
3. May #124
4. June #125
5. September #126
6. December/January #127

**Pest control advisor involvement**

Approximately 15 Pest Control Advisors (PCA) were asked to review and if possible try using monitoring techniques under evaluation during the 2000 and 2001 seasons. At meetings held in October 2000 and spring 2001, the PCA's and the project team met and discussed the monitoring techniques. Following are highlight points made at those meetings:

1) Many of the monitoring techniques took too long to implement. Many PCAs reported that they could not spend more than one-hour per week in an orchard. One PCA said he could not spend more than 30 minutes in an orchard. Suggestions made to speed up the monitoring procedure included: using a timed search rather than looking at a certain number of trees, look at one side of tree only rather than walking around tree, rather than recording data just keep a mental note of abundance of the pest being monitored.
2) Several PCAs reported that they use a more subjective monitoring technique. The quantitative monitoring under evaluation takes too long.
3) The PCAs all agreed that the treatment thresholds were about right and about the same that they have been using.
4) Most PCAs found that the dormant spur sampling technique was useful and even though it took some time, the winter is when they have more time and it required monitoring only once per season.
5) The PCAs found that the tree and fruit monitoring technique were useful but agreed that it took too long and too many trees had to be looked at before a decision could be made.
6) PCAs felt that the springtime aphid monitoring technique was useful but preferred quickly covering the entire orchard rather than the quantitative approach as stated in the monitoring technique.
7) PCAs found that the pheromone traps provided little if any useful information and recommended discontinuing their use.

Overall, the PCAs were pleased to be involved in the project. As stated in the highlighted points of the meeting, the PCAs favor more subjective methods of monitoring. However, for this project, quantitative methods must be used in order to determine what treatment threshold and/or monitoring techniques are the most accurate. When the techniques and thresholds are finally presented to all involved in the dried plum industry, it is understood that many will use subjective techniques and shortcuts in order to save time and money.

**Securing additional grant support:**

Additional grant support was solicited and secured from several sources. Listed below are the sources of each additional grant that is being used to support this project:

CALIFORNIA DRIED PLUM NEWS
Integrated Prune Farming Practices
IPFP NEWSLETTER
No. 127 January 2003

# INTEGRATED PRUNE FARMING PRACTICES (IPFP) - PROJECT WINDS UP A SUCCESSFUL 5TH YEAR RESPONDING TO CHANGE

## WHAT IS IPFP?

Your California Dried Plum Board responded to public concern for agriculture's impact on environmental quality, human health, and worker safety. In 1998, it assembled a coalition of industry, educational, environmental, and regulatory agencies to develop an array of statewide projects to research, demonstrate, and integrate environmentally sensitive economic cultural programs for dried plum culture – the "Integrated Prune Farming Practices (IPFP) program on behalf of the dried plum industry, IPFP is intended to address the inevitable restrictions the federal Food Quality Protection Act, Clean Air Act, Clean Water act, and California ballot initiatives, Propositions 65 and 204, will have on agriculture, particularly dried plum culture. *

## IPFP PROJECT GOALS

1) Develop, and evaluate reduced environmental risk protocols for pest control, irrigation and tree nutrition for California dried plum growers.
2) Educate dried plum growers in reduced environmental risk prune farming practices.
3) Ensure widespread industry integration of IPFP practices into dried plum farming programs.

*** The financial coalition and management team are listed at the end of this newsletter.**

IPFP has completed its 5th year and accomplishments include considerable reductions in the need for pest treatment, irrigation and fertilization. **In addition to environmental benefits, per acre cost savings to growers are considerable using IPFP practices.**

**Pesticides and costs were reduced – you can save this money too:**

- ***Dormant treatments often not needed:*** Conventionally, dormant sprays (usually oil combined with Diazinon or a pyrethroid) are always applied as an annual "clean-up" spray to prune trees for scales, peach twig borer, and aphid and mite eggs. Now that "times are tight", the need to reduce costs is essential. The IPFP program developed, and has implemented, a "treatment decision guide" to determine: 1) do you need a treatment and; 2) whether conventional or "low environmental risk" pesticides are appropriate. By considering IPFP's technique of using an orchard's past history for aphids, then sampling and observing dormant spurs for scales and aphid eggs, growers/pest control advisors (PCA's) can determine treatment thresholds and strategies to avoid potential problems.

IPFP project growers used this history/ sampling procedure (developed in the project in 2001) during the winter of 2001/02 as a decision guide. Interestingly, ~57% of the orchards in 2002 (~61% in 2001) distributed from Porterville in Tulare Co. to Red Bluff in Tehama Co., did not require treatment for either scales or aphids during the dormant period. In addition to reduced pesticide use there is considerable savings if one does not need to spray.

What about aphids in the spring with no dormant spray??? If a dormant spray is not warranted because orchard history or spur counts don't indicate a potential for aphids, in-season aphid monitoring is recommended. IPFP has developed a reliable in-season aphid monitoring protocol from which control decisions can be made.

- ***Peach twig borer (PTB) treatments usually not needed either – progress report:*** Without a dormant treatment or a Bt treatment pre-bloom, there is always some concern for potential PTB infested fruit because a conventional dormant treatment controls PTB. In 2001 and 2002, IPFP used an in-season fruit monitoring technique to determine potential for damage and need for treatment. Project orchards did not require in-season treatment. Here are the details:

IPFP project growers placed PTB pheromone traps into their orchards to determine the PTB biofix (beginning flight of over-wintered moths). By evaluating 1200 fruit for PTB damage at 400 degree-days following biofix, and using an economic treatment threshold of 1% (1% of fruit from an orchard yielding 2.5 dry tons/ac sold for $800/ton would be equivalent to the cost of an in-season PTB treatment), a treatment decision could be made. In 2001 and 2002, no project orchard was predicted to have PTB damage at harvest using this technique. At harvest in 2001, one orchard had slight damage (1.3%) and none in 2002 had PTB damage above the 1% threshold.

Note that this monitoring technique is not yet recommended as a standard practice. However, if you don't dormant spray and do not apply Bt pre-bloom, project participants advise using this technique to determine the level of PTB damage so an in-season treatment can be considered if necessary.

- ***Rust treatments often not needed either:*** IPFP has been evaluating need for rust treatments; research has shown rust spots on leaves pre-harvest do not reduce soluble solids or fruit size and that post harvest defoliation due to the disease does not affect subsequent crops or crop quality. Concern develops for potential defoliation pre-harvest and its possible impact on the current season's crop.

IPFP project members have been monitoring their orchards for rust since the beginning of the project. Even though the number of orchards varies each year as to incidence and time of rust occurrence observed (up to as early as 7 weeks prior to harvest) pre-harvest defoliation has only occurred once (in 1999) in one orchard (then only ~10% defoliation).

So, here's a chance to save additional money. IPFP recommends monitoring trees weekly for rust beginning 1 May up to 4 weeks prior to harvest. If rust is detected within that period, treatment is recommended. However, no treatment is recommended if rust is detected within the 4 week interval prior to harvest as potential for pre-harvest defoliation is essentially nil.

**Irrigations (and more costs) were reduced:**

IPFP has been demonstrating regulated deficit irrigation research and verifies that reduced mid-season irrigation (up to 40%) maintains the same fruit quality and value as fully irrigated orchards. Reduced irrigation saves both money and water while reducing potential for pesticide runoff.

The technology uses a commercially available portable device called a "pressure chamber". This instrument is used to periodically measure tree-water status and compare those data with a standard curve of allowable stress. Weekly orchard monitoring and then comparison of the on-site measurement with the standard allowable curve, provides the data for efficient irrigation scheduling.

IPFP growers using this technology have, in general, irrigated one less time than conventionally managed orchards. Interestingly, those growers in the project having comparison plots (i.e. IPFP technology compared with conventional practices) are now irrigating the conventional sides on the schedule developed by IPFP. So, "money talks ...".

**Leaf tissue and/or water analyses guide N fertilizer strategies to save (or make) money:**

Applying excessive Nitrogen (N) is not cost effective and is hazardous to the environment. Conversely, orchards deficient in N are not as

productive as they could be. Established July leaf tissue levels describe N excess, sufficiency, and deficiency. So, taking leaf samples in July for leaf tissue N analyses can provide a reliable understanding of an orchard's N status and guide the N fertilizer program. Further, well water analyses (taken anytime) for nitrate N can provide information about that source of irrigation water as an N contributor to the fertilizer program.

One major goal of the IPFP program is to demonstrate the cost effective utility of using leaf tissue and water analyses to develop an N fertilization strategy. Leaf tissue and well water in IPFP project orchards have been sampled each project year. In 2002, 20% of the project orchards were found to be deficient in N, down from 48.5% in 2001. The decline in orchards deficient in N can be attributed to adjustment in the fertilizer program based upon the leaf-tissue sampling program.

Well water analyses found several IPFP project wells to contain sufficient N to supplement the topical N fertilization program. Using the N from wells, as a portion of the N fertilization strategy is a direct savings to dried plum growers.

## IPFP IS DEVELOPING OTHER TECHNOLOGIES TO MAXIMIZE DRIED PLUM ORCHARD EFFICIENCY, MINIMIZE COSTS AND, AVOID ENVIRONMENTAL IMPACT

- **Predicting Oblique Banded Leaf Roller (OBLR) damage:**

Orchard history has been the conventional means for determining need for an OBLR treatment of two Bt bloom-time sprays. In lieu of the bloom-time spray and the potential to avoid that expense, IPFP is testing feasibility of a "one time", in-season fruit sampling technique that predicts extent of damage at harvest and need for treatment.

Starting at 690-degree days from the moth's biofix, three weekly fruit observations are made to determine if damage exceeds 1% (the economic threshold for treatment) and any need for treatment. The technique appears promising but additional field research will be needed to ensure accuracy.

- **Using "presence/absence" sequential sampling and/or a "5 minute search" for mites:**

Subjective judgment is the conventional method of determining need for web spinning mite treatment in dried plums. To be more objective, almond PCA's use a presence/absence sequential sampling technique for that crop that evaluates both mite and predator presence on leaves to make a decision. IPFP, because the almond method is far too time consuming, is comparing a 5-minute search (i.e. looking for mite symptoms and examining leaves for both mites and predators) with the presence/absence method.

Treatment decision information gained from a 5-minute search was well correlated with that from a presence/absence procedure and is much quicker. Although additional years of validation are needed, the procedure appears to be a promising substitute.

- **Fruit brown rot predictive model:**

There is no current pre-harvest method of determining potential for economic brown rot at harvest and need for pre-harvest treatment. An "Over Night Freezing/Incubation Technique" (ONFIT) that determines brown rot presence from latent infections on fruits in early June is being tested by IPFP; latent infections are known to be correlated with harvest brown rot.

ONFIT did predict low levels of brown rot in several orchards during the last three years of the project. However, due to conditions not conducive to brown rot development, economic levels of the disease were minimal at harvest.

## Want to use IPFP management strategies in your orchard?

Your local University of California Cooperative Extension Farm Advisor or IPFP management team member (see list below) has treatment decision guides. Feel free to contact one of these people for the guides and assistance in utilizing them.

**IPFP provides some foundation for Sacramento River Water Stewards**

Organophosphate insecticide runoff, primarily Diazinon, into the Sacramento and Feather Rivers from agricultural activity is a major environmental concern. Since the early 1990s, northern California orchard growers have been apprehensive about OP runoff traced to their dormant applications in almond, dried plum, and peach orchards following winter rainstorms.

The Sacramento River Watershed Program (SRWP) and its internal Organophosphate Focus Group (OPFG), made up of stakeholders from agriculture, the pesticide industry, state and federal agencies and other interested groups, addresses the Diazinon runoff problem. The SRWP provides funding and facilitates development of management strategies developed by various stakeholder groups such as IPFP to mitigate runoff and improve water quality in the Sacramento River watershed.

Management strategies developed within IPFP are now being recommended as major mitigation efforts to reduce Diazinon runoff within the SRWP. A "Water Steward" program, launched in 2001 originating from activities related to the SRWP, is in its second year of a campaign to raise orchard grower awareness of pesticide runoff into the watershed. In late December, almond, peach, and dried plum growers were mailed two informational booklets outlining pest control and orchard management practices developed within IPFP for protecting surface water from dormant orchard spray runoff. The grower mailing, part of the Water Steward program, was organized by the Coalition for Urban/Rural Environmental Stewardship (CURES) and funded by a grant from the CALFED Watershed Program.

**Water Steward program packets mailed to growers**

"*Orchard Practices to Protect Water Quality*": a 20-page booklet summarizing pest control and orchard site practices showing most promise for reducing pesticide runoff from dormant orchard sprays.

"*Orchard Air Blast Sprayers; Tips and Techniques for Protecting Water Quality*": an 8-page booklet covering sprayer mixing/ loading and application practices to protect surface water.

Water Steward information packets are also available at Sacramento Valley crop protection product retailers and County Agricultural Commissioner's offices. The publications can also be ordered on the CURES website (www.curesworks.org) or by calling 916-646-9951 and leaving mailing information.

Included in the Water Steward mailing is a response form growers are encouraged to return to CURES. "Grower response is critical in helping us prove to state regulators that orchard growers care about protecting water resources and can make a difference," says CURES Executive Director Parry Klassen.

As well, for the second year in a row, Director Klassen is continuing presentations at grower and crop consultant meetings in the Sacramento Valley, outlining practices that orchard growers can adapt to their own farming operations.

The Water Steward program is continuing to coordinate their efforts with a CALFED and 319h projects managed by the California Dried Plum Board. In these dried plum pest control studies, additional management practices are being evaluated for effectiveness in controlling pesticide runoff. In coming years, the two projects will further promote demonstration field days and other activities related to the projects that mitigate runoff problems. Also, an orchard site assessment and additional spraying "best management practice" (BMP') training materials in English and Spanish will be provided.

Other runoff issues for dried plum growers - conditional waiver adopted

A two-year conditional waiver from runoff water discharge requirements was recently granted to growers by the Central Valley Regional Water Quality Control Board. In a public hearing December 5, 2002 in Sacramento, the Board

adopted a plan that covers discharges from irrigated land and managed wetlands.

As "conditions" of the waiver, growers will be required to begin identifying and monitoring pollutants washed off fields and develop plans for reducing them. Further, the waiver requires agriculture to:

1. Organize "watershed groups" to represent the various drainages in the Central Valley. These would make voluntary efforts to monitor and cut pollution in areas drained by the same river system.

2. Develop water quality monitoring plans that examine farm runoff from irrigation flows and storm water and provide progress reports to the Regional Board.

If the Regional Board determines adequate progress is being made and there are no major water quality problems, the watershed group will continue its efforts to comply with the waiver requirements and timelines adopted by the Regional Board. If a water quality problem persists, the Regional Board can revoke the waiver for entire watersheds, sub-watersheds or individual discharges and can also utilize its existing authority to enforce illegal discharges.

The Regional Board also directed its staff to undertake a full environmental impact report (EIR) that assesses long-term impact of the conditional waiver. Staff will also be holding public workshops every six months to assess progress of agriculture's compliance with the waiver. Additionally, within two years, staff must develop a ten-year plan for mitigating adverse impacts on beneficial uses that result from run-off from irrigated lands, including periodic targets to measure progress.

## IPFP COALITION PARTNERS

### Financial support team

- California Dried Plum Board
- Nature Conservancy
- USDA/Natural Resources Conservation Service (NRCS)
- USDA/Cooperative State Research, Education, and Extension Service (CSREES)
- CalEPA'S Department of Pesticide Registration (DPR)
- Sustainable Agriculture Research and Education Program (SAREP)/Biologically Integrated Farming Systems (BIFS)
- University of California Cooperative Extension

### Management and Grower Support Teams

- The IPFP management team consists of 15 University of California farm advisors, specialists, and experiment station personnel, 6 industry representatives, 9 Pest Control Advisors, and 33 grower/cooperators.

Rick Buchner - Tehama Co. Co-op Ext., UC
Mark Dalrymple - Sunsweet Growers, Inc.
Brent Holtz - Madera Co. Co-op Ext., UC
Mark Kettmann - Mariani Packing Co.
Bill Krueger - Glenn Co. Co-op Ext., UC
Nick Mills - Entomologist, UC
Maxwell Norton, Merced Co. Co-op Ext., UC
Gary Obenauf - Project Manager CDPB
Bill Olson - Farm Advisor-Butte/ Sutter/ Yuba
Rich Peterson - Executive Director, CDPB
Carolyn Pickel - Area IPM, UC
Wilbur Reil - Yolo Co. Co-op Ext., UC
Ken Shackel - Pomologist, UC
Steve Sibbett - Consultant
Beth Teviotdale - Plant Pathologist, UC
Fred Thomas - BPS Coordinator
Becky Westerdahl - Extension Nematologist, UC
Larry Whitted - Whitted & Associates

**Prune Growers:**
Dan Aguair
Mike Billiou - Billiou Ranches
Dan Bozzo
Mike Braga - Sherman Thomas Ranch
Brother Paul - Abby Ranch
Gary Carlin
Bruce Carroll - Big M Ranch
Greg Correa - Onstott Orchards
Mike Davis - Sycamore Ranch
David Evers - Farmland Management
Brendon Flynn - Minch Ranch
Earl Giacolini
Steve Gruenwald
John Heier
Dick Jacobs - Chico State Farm
Kulwant Johl
Brad Johnson - Johnson Clan
Bob Kolberg - Greenleaf Farms
Roger Sohnrey -Sohnrey Ranch
George Toney - Toney Orchards
Joe Turkovich
Don Vossler
Gary Walker - Growers Ag Service

CalEPA/DPR/PMA
UC/SAREP/BIFS
USDA/CSREES
USDA/NRCS
USEPA/Region 9

The new grants secured will allow this project to evolve in 2002 maintaining approximately at 25 field sites and renewed efforts towards technology transfer via newsletters, grower meetings, working with PCAs and measurements of impact of project on the industry. With the support of the California Dried plum Board and other sources of grant support, this work can continue to produce "reduced risk" pesticide and cultural options for dried plum producers.

**Pesticide use reporting:**

One of the main goals of the IPFP project that began in 1998 was to reduce the amounts of Organophosphate pesticides applied. Shown below, in Figs. 19 and 20, are pounds of active ingredient applied per acre to dried plums from 1998 to 2000 for all bearing dried plum acreage in California. Both Diazinon and Supracide have decreased since 1998, while Asana has remained almost the same (Fig 19). The amount of sulfur has decreased the most over the three years (Fig 20).

**Fig 19.**

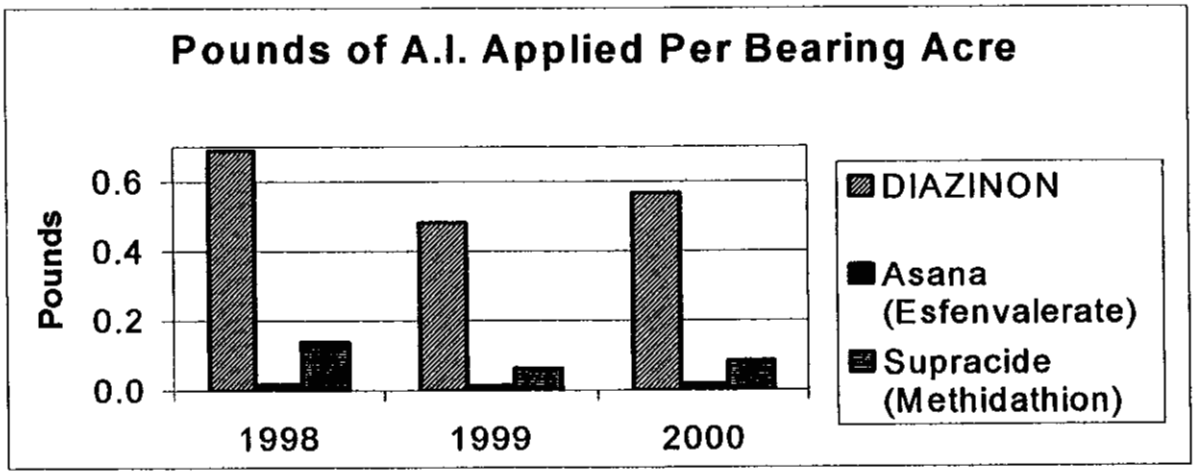
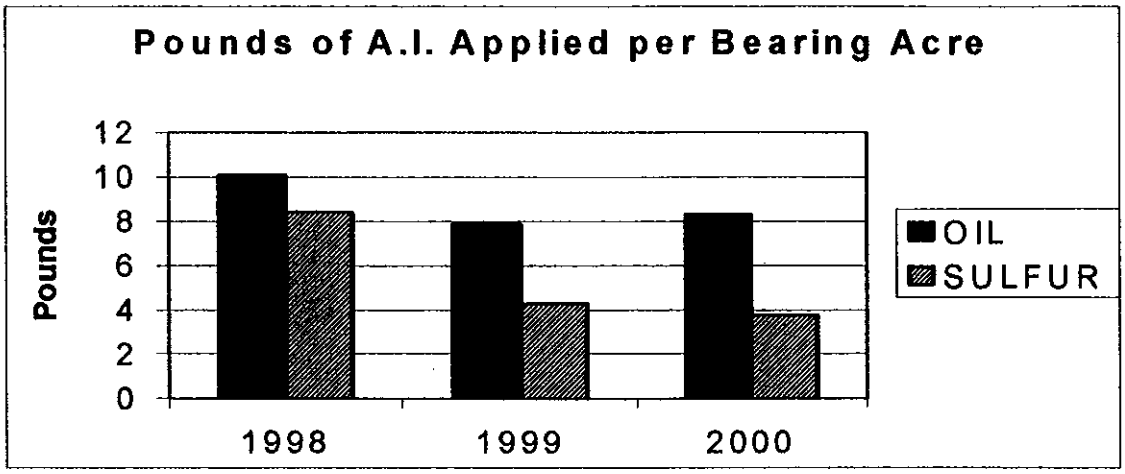


Fig 20.




Pesticide Use Reporting (PUR) data from 1992-2000 was generated for all the growers in the 12 counties of the IPFP Program with the help of UC/SAREP/BIFS and Dr. Minghua Zhang. Figures 21-25 show the pesticide use trends of the highest used materials for the five leading dried plum counties. Generally, we are seeing reduction trends in materials like Diazinon but there are differences in different counties that we need to evaluate further. We have the use data for most of the pesticides used on dried plums and we will be spending a lot of time over the next several months looking at the data to help us determine:

1. Pesticide use trends.
2. Impact of the IPFP Program.
3. Identify areas we need to increase our efforts to implement reduced risk pesticide use.

The PUR data also allowed us to compare each pesticide in the conventional and reduced risk orchards in each county. Figures 26-29 are examples of Diazinon use in the leading dried plum counties. Again, this is a tremendous amount of information that will take several months for us to evaluate and will be reporting more on it at a latter date.

**Fig 21: Pesticide Use Trends Sutter**

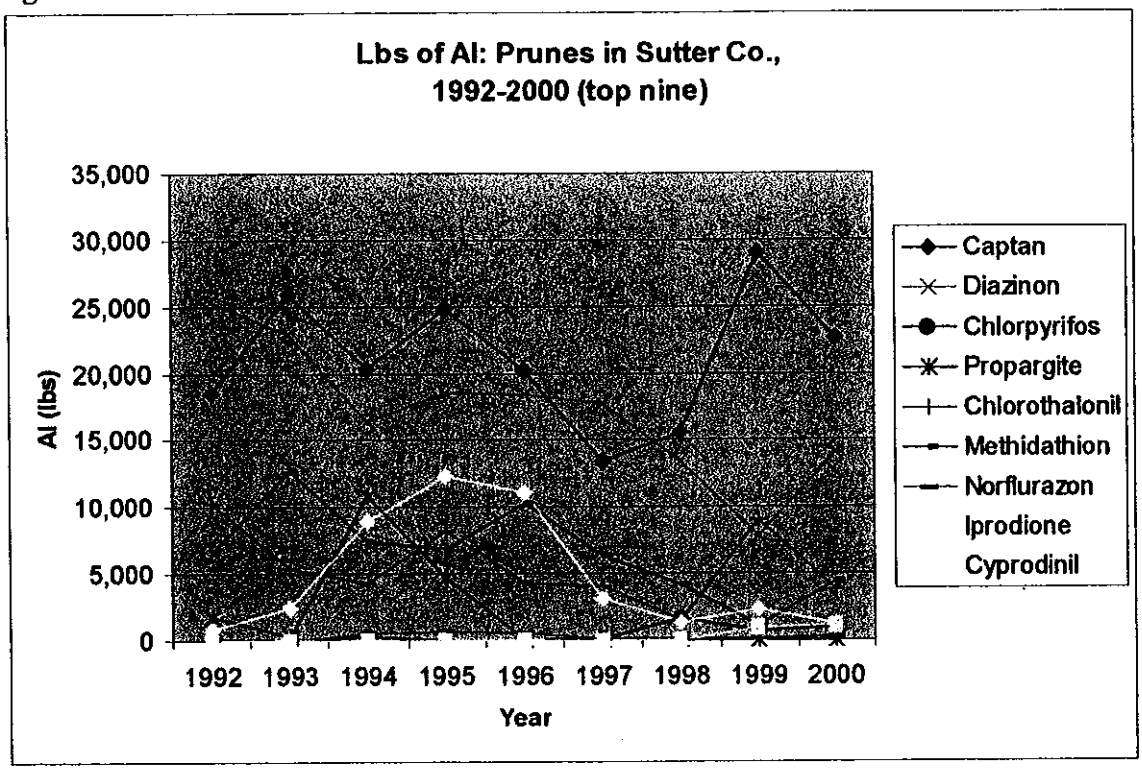



**Fig 22: Pesticide Use Trends Tehema**

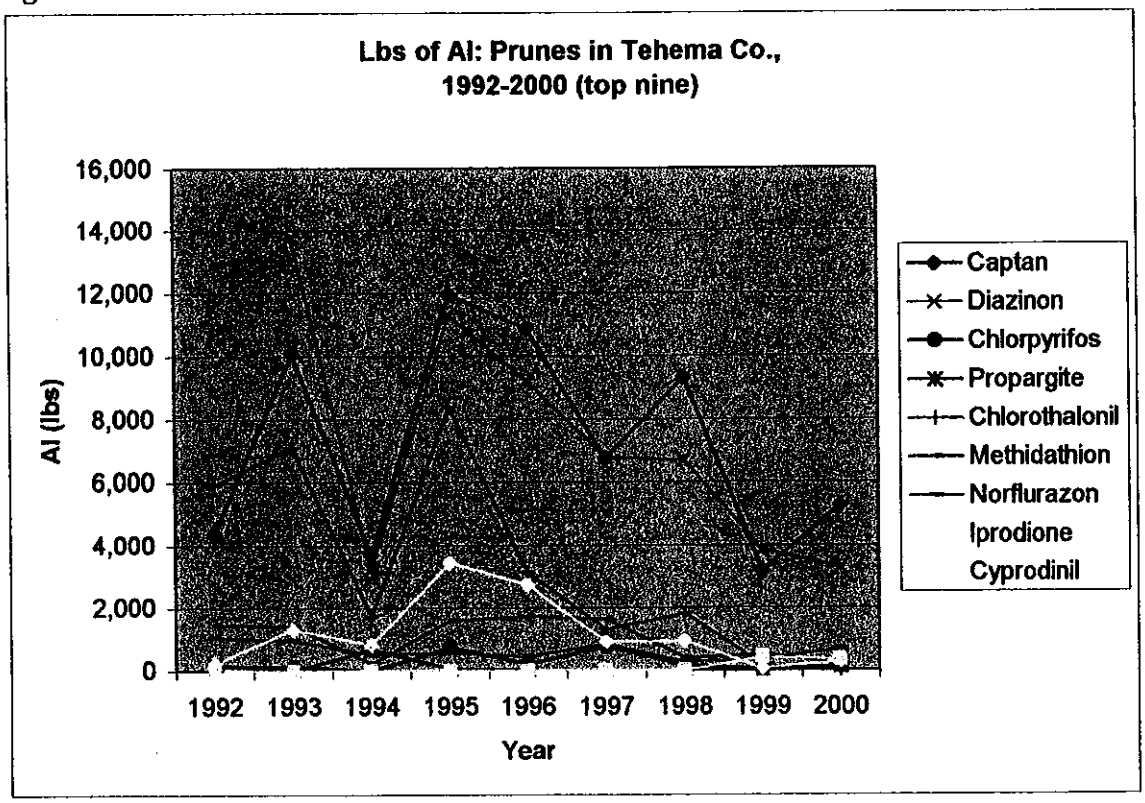


**Fig 23: Pesticide Use Trends Tulare**

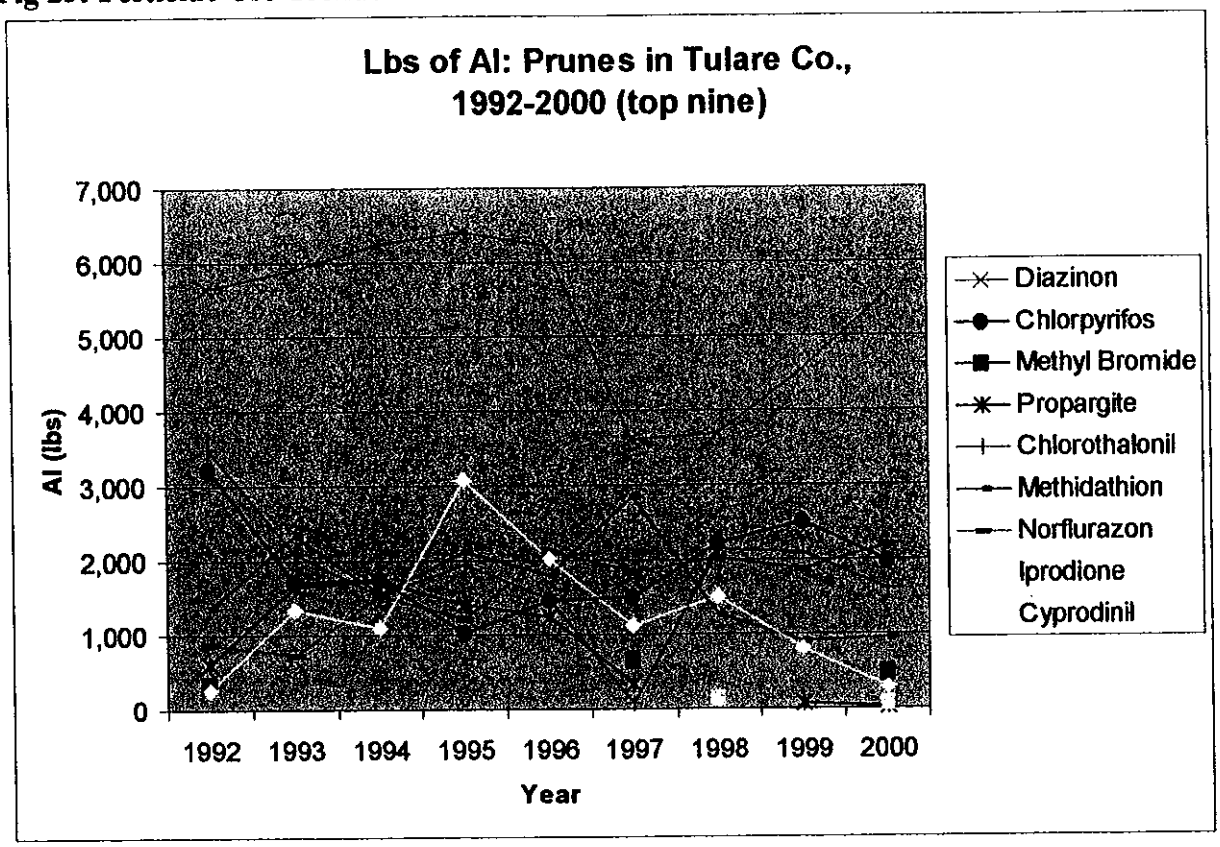



**Fig 24: Pesticide Use Trends Glenn**

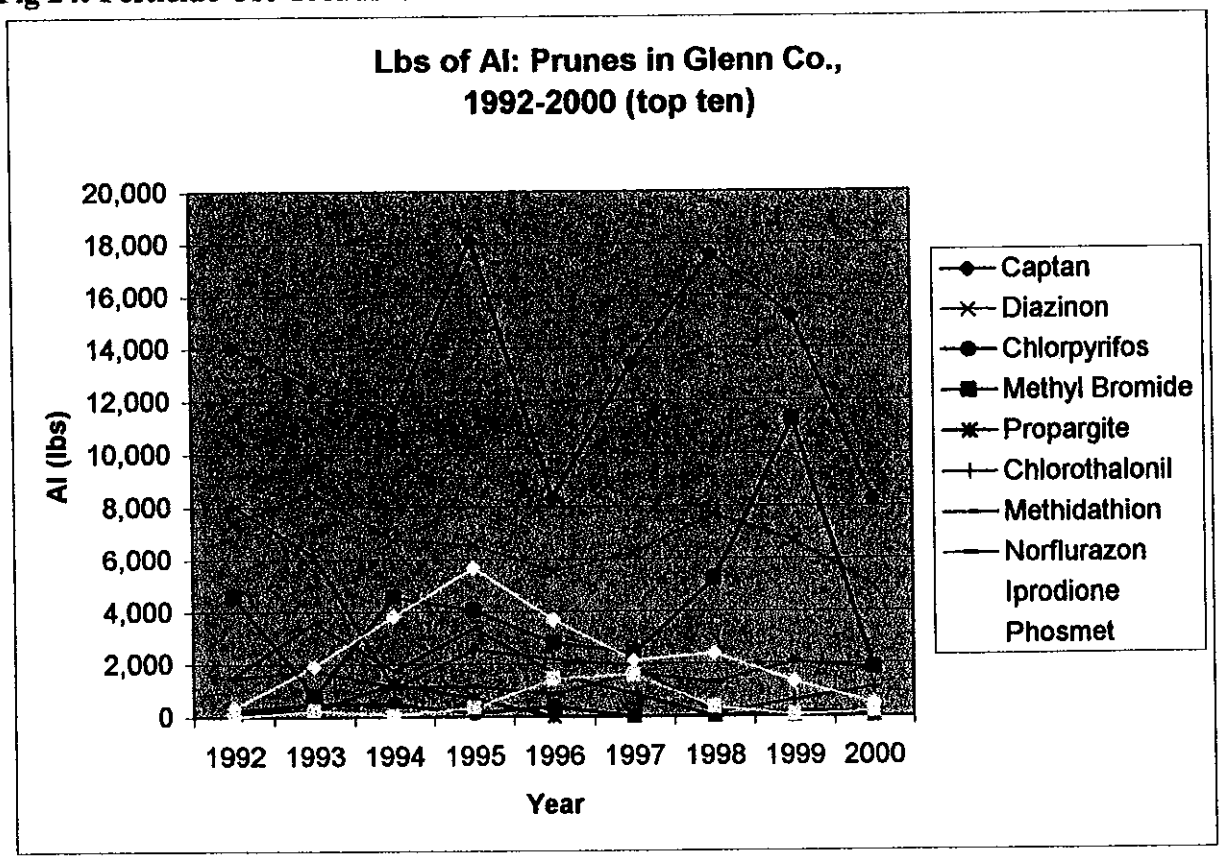


**Fig 25: Pesticide Use Trends Butte**

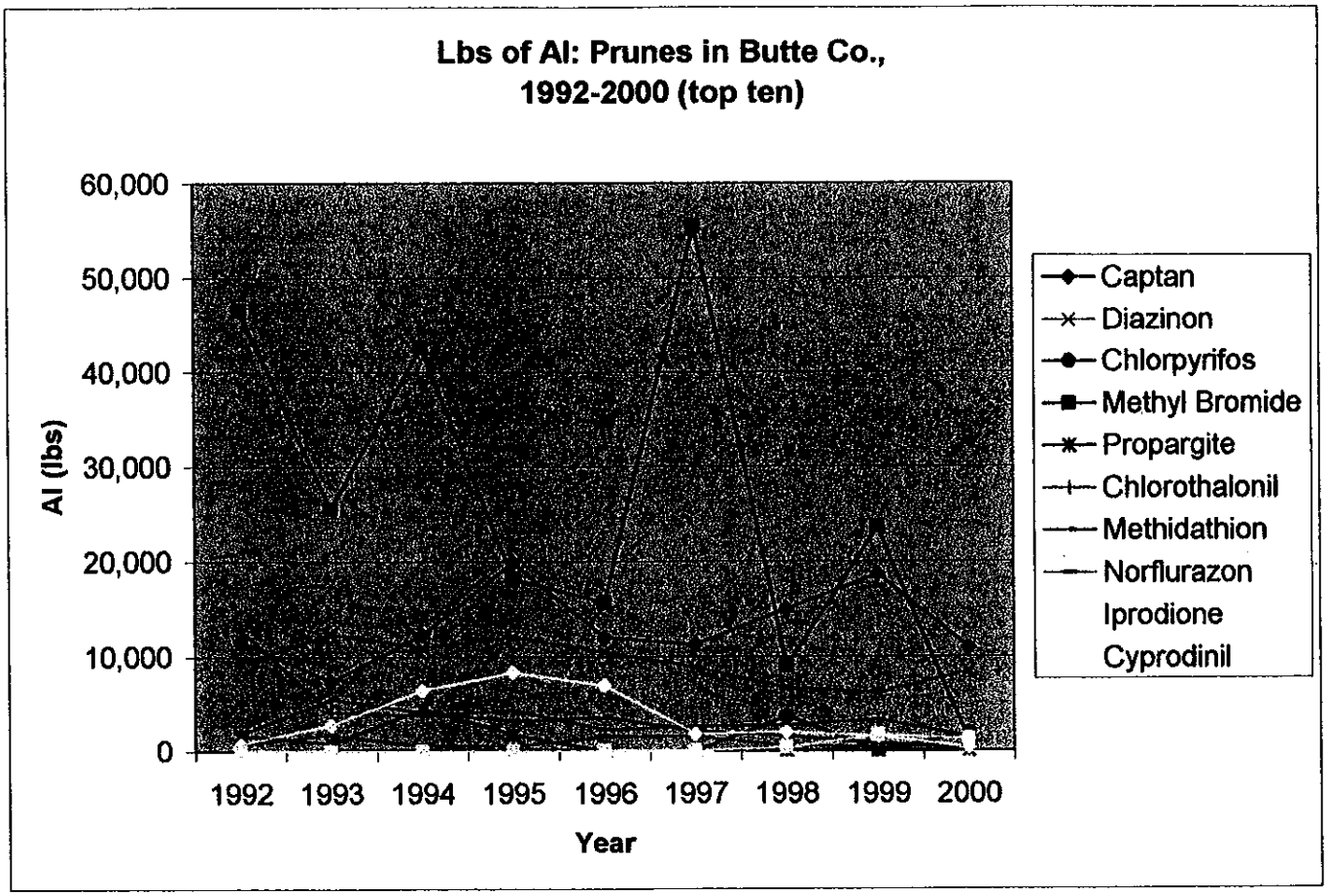


Fig 26.

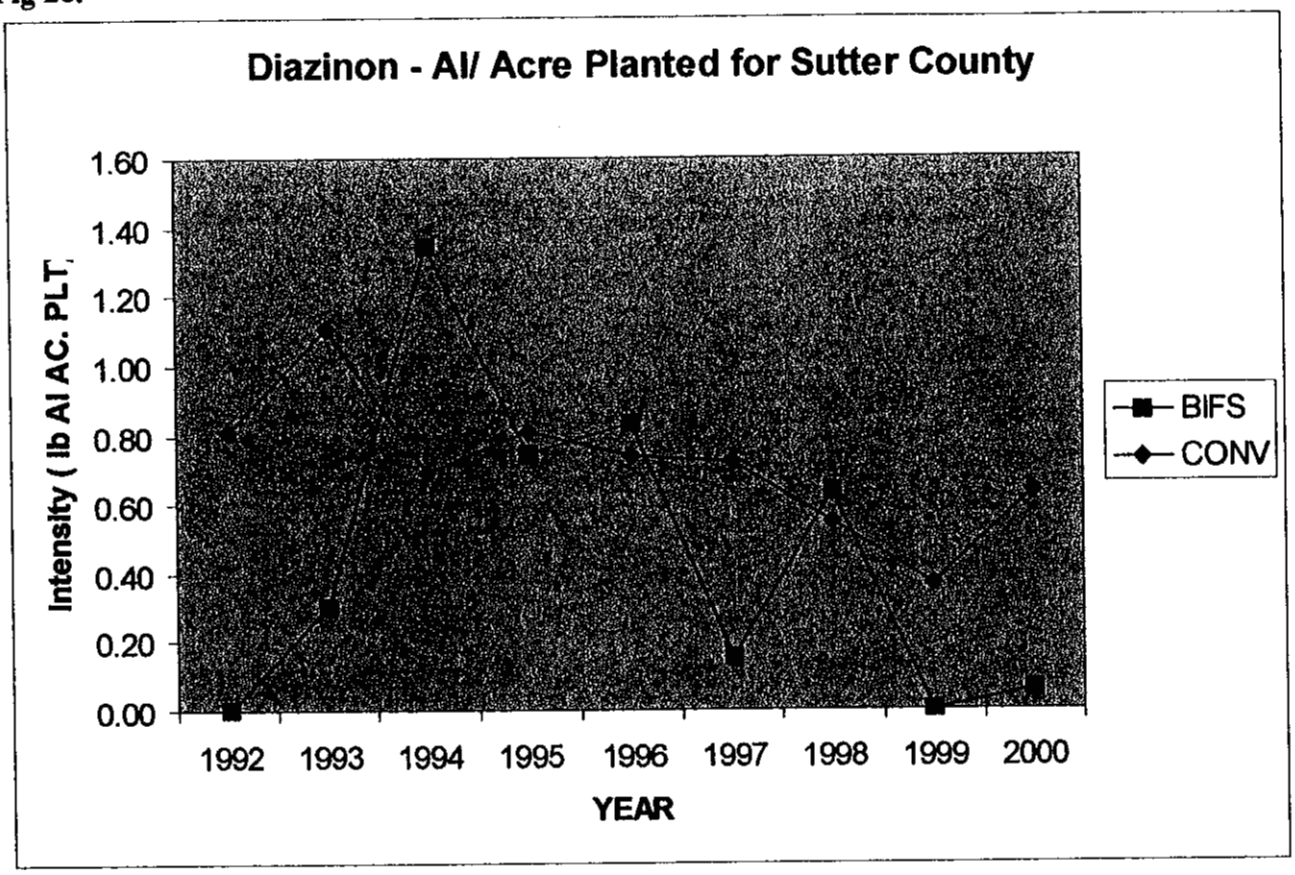

Diazinon - AI/ Acre Planted for Sutter County
Intensity ( lb AI AC. PLT
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1992
1993
1994
1995
1996
1997
1998
1999
2000
YEAR
BIFS
CONV

Fig 27

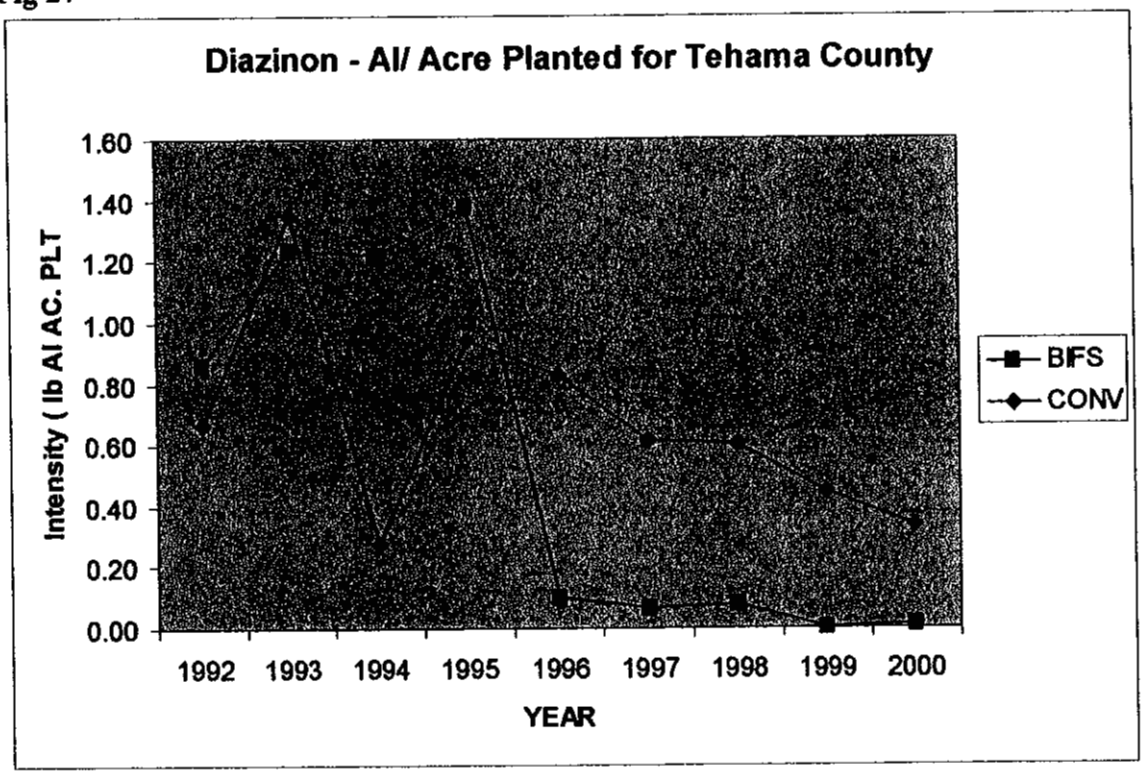

Diazinon - AI/ Acre Planted for Tehama County
Intensity ( lb AI AC. PLT
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1992
1993
1994
1995
1996
1997
1998
1999
2000
YEAR
BIFS
CONV

Fig 28

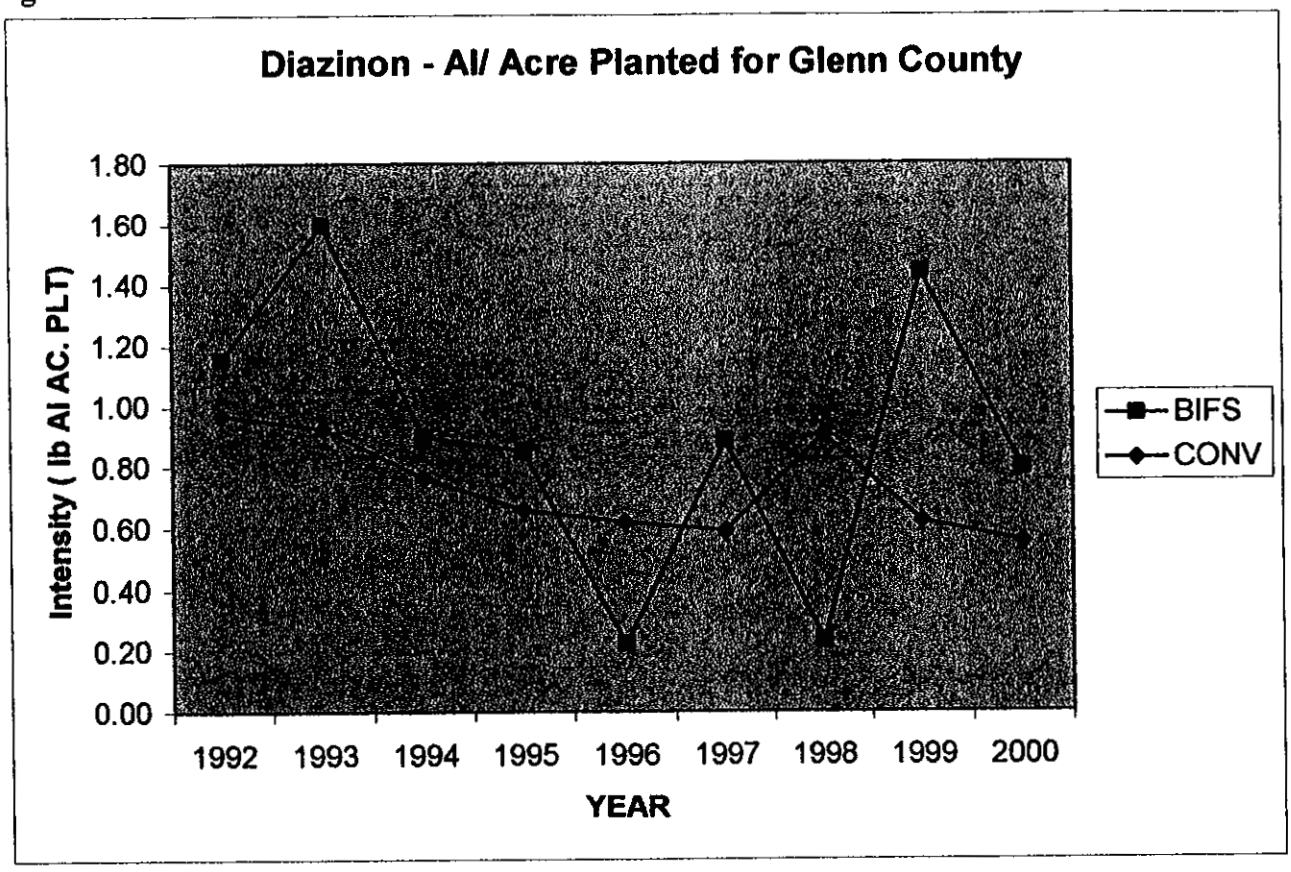
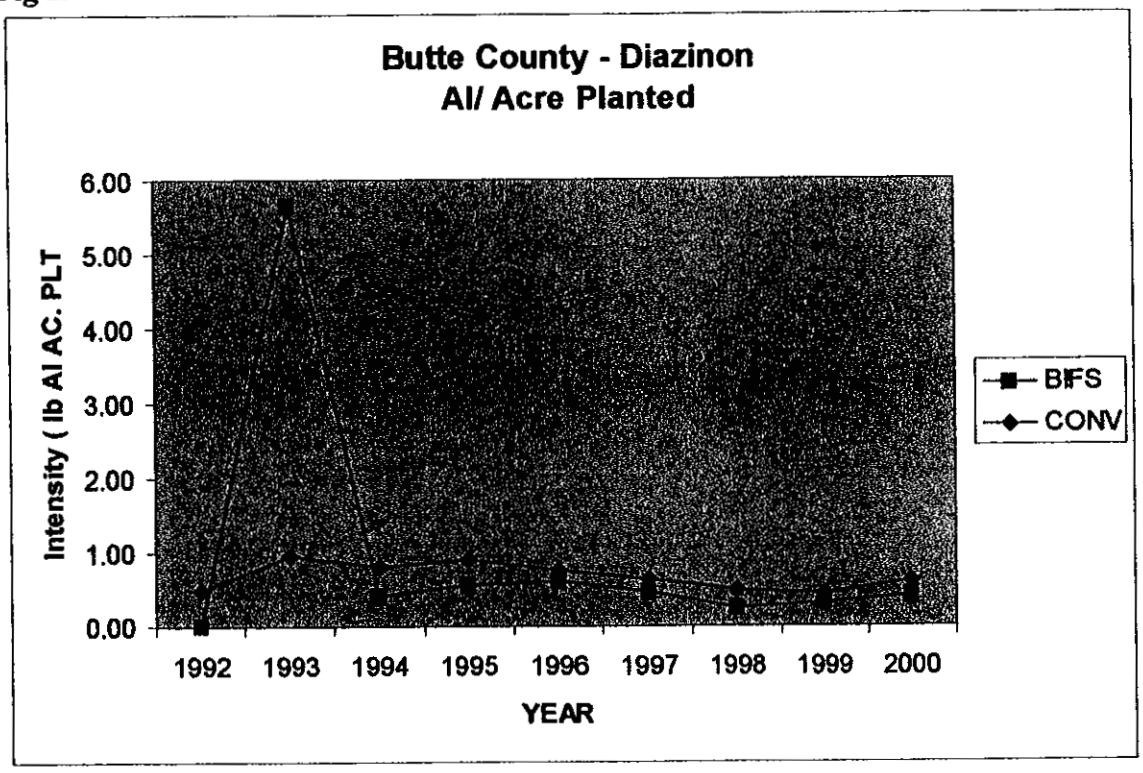

Diazinon - AI/ Acre Planted for Glenn County
Intensity ( lb AI AC. PLT)
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1992
1993
1994
1995
1996
1997
1998
1999
2000
YEAR
BIFS
CONV

Fig 29


Butte County - Diazinon
AI/ Acre Planted
Intensity ( lb AI AC. PLT
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1992
1993
1994
1995
1996
1997
1998
1999
2000
YEAR
BIFS
CONV

Typical pesticide applications of IPFP growers in 2002 in the conventional and reduced risk blocks are shown in Table 23. When a dormant treatment is needed we recommend an alternative to Diazinon but in a couple of cases the grower has decided to use Diazinon.

**Table 23.**

| Pesticides Applied in IPFP Comparison Orchards in 2002 | | | | | |
|---|---|---|---|---|---|
| **Orchard** | **County** | **Grower's Standard (Conventional) Block** | | **Reduced Risk Block** | |
| | | **Product** | **Amount/Acre** | **Product** | **Amount/Acre** |
| **Red Bluff Farms** | Tehema | Rovral/Oil | 1.5lbs / 2 gal | Captan | 4 lbs |
| | | Diazinon | 1 pt | Diazinon | 1 pt |
| | | Captan | 4 lbs | | |
| **Monestary** | Tehema | Diazinon/Oil | 2 pt / 2 gal | None | |
| | | Vanguard/Oil | 5 oz/2 gal | | |
| **Giacolini** | Fresno | Asana/Oil | 10oz/4 gal | none | |
| **Vossler** | Tulare | Asana/Oil | 10oz/4 gal | None | |
| | | Vendex | 2 lbs | | |
| | | Potassium Nitrate | 10 lbs | | |
| **Aguair** | Tulare | Asana/Oil | 10oz/4 gal | Oil | 4 gal |
| | | Potassium Nitrate | 10 lbs | | |
| | | Sulfur | 6 lbs | | |
| **Johl** | Yuba | Asana/Oil | 8oz/4 gal | Captan | 6 lbs |
| | | Captan | 6 lbs | Orbit | 4 oz |
| | | Orbit | 4 oz | | |

Comparison of conventional and reduced risk practices being demonstrated and/or researched are shown in Table 24.

**Table 24. Comparison of conventional and BIFS alternative practices**
(Extracted from the narrative in the IPFP/BIFS Final Report, March 2002)

| CONVENTIONAL PRACTICE USED | BIFS ALTERNATIVE PRACTICE DEMONSTRATED |
|---|---|
| Annual dormant insecticide treatment | Dormant spray decision guide, spring prune aphid monitoring/ reduced risk oil treatment |
| Annual dormant; annual worm spray | Pheromone trap monitoring for PTB |
| Annual in-season sulfur spray | Prune rust monitoring |
| Prophylactic mite spray, spray based on visible damage or calendar date | Monitoring for presence/absence of mites/predators, 5-minute search for mites |
| Prophylactic brown rot spray | Brown rot predictive model |
| Irrigation timing based on soil moisture measurements, timing of other orchard practices, or calendar schedule | Tree water status to schedule irrigation |
| Fertilizer needs estimated without leaf and water analysis | Leaf and water analysis to determine fertilization needs |

**New directions in the IPFP project:**

- Defoliation of the orchard early in the fall will be further evaluated as a control of Dried plum

Aphids

- Reduced rates of Diazinon and Asana in a dormant application will be further evaluated for control of aphids.
- Pest control advisors (PCA's) will continue to be involved in the project by using the monitoring techniques in some demonstration plots. Because of budget reductions, PCAs will not be paid to monitor blocks with our protocols. We will have one or more meetings in the fall of the year with PCAs to get their input on the progress of the protocols.
- Some of the monitoring techniques will be modified so that they can be conducted faster and made more "PCA friendly."
- IPFP will hold "how to" workshops with a binder on monitoring pests, nutrients, cover crops, watershed issues and irrigation. The workshops are tentatively planned for May 28-20 and June 3-5 2003.
- Meetings in classroom style and field meeting will be held as in past years.
- Working with an agricultural economist at UC Davis, we will look at the cost of our monitoring techniques.
- Efforts are underway to combine information we have learned in the IPFP program with the Water Steward Research and Demonstration (WSRD) Program. Starting in the spring of 2003, joint management team meetings will be held.
- We do not plan an exit strategy until we accomplish our goals of getting the Dried Plum Industry to implement reduced risk pesticide use practices or we run out of funds to do so. When we get close to that point, we will develop an exit strategy based on where we are stand at that time.